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There usually is a good deal of work going on in Chicago which is of interest to railway engineers, and a number of pieces of important work are being done at the time of this year's convention of the Maintenance of Way Association, some of which will be described in the Daily Railway Age Gazette. The most important is the construction of the new passenger station and terminals of the Chicago & Northwestern, which it is estimated will cost $20,000,000. At Grand Crossing is being done the greatest piece of track elevation in the country. The driving of the tunnels of the Chicago Railways Company under the Chicago River at Washington and La Salle streets has many interesting features. The Northwestern has been doing, and the St. Paul now has under way, at Evanston, track elevation having some unusual aspects. In the different parts and suburbs of Chicago, grade separation work may be seen which is being carried on under various conditions and according to diverse methods devised by a large number of railway engineers. At Thirty-first street and Campbell avenue an 8-track Scherzer rolling lift bridge is being built for the use of the Pennsylvania Lines, the Chicago Junction Railway and the Chicago Terminal Transfer Railroad. No doubt, many of the visiting engineers will take advantage of the opportunity to see some or all of this work.

The long discussion on the economics of location yesterday morning brought out some consideration of details that would probably not have seen the light of day had the time limit been more closely drawn. One of these was that it might be well to consider the condition of the locomotive at the end of a long pull. An engine that may enter a grade with fire in first-class condition might have it in very bad shape at the end, so that, as was suggested, it would be a good idea to ease off on the requirements at the end by increasing curve compensation or even cutting down the rate of tangent grade. That the doctors should diagnose in this matter of curve compensation, is small wonder, for it is evidently one of those items of location that must be governed by local conditions. So, while the 3.05 per cent. recommended for general use may be all right, there was probably not a man in the room who voted for it without making mental reservations as to his own practice. In discussing curve work there was brought out, in a very marked manner, the difference that may exist between theoretical construction and practical maintenance. The committee recommended that the superelevation on curves should be obtained by elevating the outer and depressing the inner rail an equal amount, which would thus be one-half the desired superelevation. It was conceded that this would be easy enough on new work where the grade stakes were available for reference, but after these had disappeared, how was a section man to do his work? A question to which no satisfactory answer was forthcoming.

Registration records, admitedly incomplete, because of the tendency to procrastinate about comparatively insignificant matters, showed 411 members registered up to noon on Wednesday. It is probably safe to estimate a total attendance of 500 members. This doubtless is the largest attendance in the history of the Maintenance of Way Association. This, like last year's proceedings, show the increasing strength and importance of the organization.

COMMITTEE ON RAIL.

The problem before the Committee on Rail is probably one of the most important which has come to the attention of the Maintenance of Way Association, involving, as it does, a number of opposing factors.

From the standpoint of the public, the destruction of life and limb through derailments caused by the breaking of defective rails, is almost the sole point of interest in connection with rail manufacture. To the railway company, also, this feature is of the utmost importance, while the cost of rail wear, which is one of the large items in the cost of roadway maintenance, is assuming greater and greater importance with the rapid increase in the density of traffic.

An improvement in the method of manufacture of rail, which would result in doubling the wearing capacity of rail under traffic, as compared with present conditions, would probably mean an average gross saving to the railways of the United States of not far from $20,000,000 per year. From this, of course, must be subtracted the increased cost of producing this better quality of material. As the cost of manufacture of any article is, in the end, borne by the consumer, this, of course, means that the net saving in this item would, in the end, be felt in reduced cost of transportation to the shipper.

The securing of rail free from defects would seem to be largely a question of furnace practice—of the production of a sound ingot. The securing of increased life of sound rail under traffic is, however, affected by many factors, including the furnace practice, the mill practice, the chemical composition, and the design of the rail.

In the report of October, 1907, of the American Railway Association Committee on Standard Rail and Wheel Sections, working with the Manufacturers' Committee, the following paragraph occurs:

> The joint committee endeavored to unite upon a single design or type of section for the roads, but, due to the varying conditions throughout the country, or due to the fact that there are many adherents among railway engineers to each of two distinct types, it seems out of the question at the present time to reduce the number of types to less than two.

The varying conditions throughout the country referred to as affecting rail design probably consist solely in the variation, on different railways, of the relative per cents. of straight and curved track and in the sharpness of the curves.

It has been suggested that, while it is true that different railways vary greatly in the per cent. of straight line and curvature, yet the conditions of wear on straight line are practically the same on all railroads, and also the conditions of wear on curved track are the same on all railroads. Therefore, a rail designed for use solely on straight line would be equally satisfactory for straight line in all parts of the country. By simply adding to the depth of the rail head, a design especially suited to curve wear would be produced, and these two designs would have the same splicing section. By adopting one of these sections as standard for frogs and switches and by laying it through all turnouts, it would appear that but few practical difficulties would result from the common use of these sections of rail on all roads having any considerable proportion of straight line.

As rail wear and lack of stiffness are the final cause of over 90 per cent. of rail renewals, defects accounting for not much over three per cent., it is hoped that the Association will investigate this possibility as well as merely report on the best compromise type of section that can be designed.

WASTEFUL TIE SPECIFICATIONS.

Fully 90 per cent. of the hewn ties now used are cut by a large number of small cutters from scattering timber. In spite of this fact there has recently developed a tendency among the maintenance of way engineers to allow too small a margin in variations from dimensions of hewn cross-ties. For instance, specifications have been drawn for ties to be furnished 95 per cent. number one ties (full and exact dimensions). The source of supply in eastern territory is largely oak and pine, ties being cut from trees that will make only one tie to each 8 ft. or 8½ ft. length. In the oak district trees will cut about three ties to the tree and will average two number one ties and one number two. In the pine district the timber will cut about four ties to the tree and will average three number one ties and one number two. Fortunately for the tie supply and the stockholders of the railways all engineers do not insist on the same amount of number one ties. Should they all agree on demanding 90 or 95 per cent. of number one ties the increase in price due to waste and loss of timber would come very quickly. If difference of opinion as to policy continues the engineers who insist on an unnatural percentage of number one ties will have to pay more for their cross-ties, and in times of scarcity or active demand will have difficulty in securing their supplies.

There also appears to be a tendency to construe specifications more rigidly and to endeavor to secure hewn ties with as little variation in size as if the material was sawn. This is impossible, and if hewn ties of good timber, one-half inch under in size at any point, are rejected, it is as wasteful as it is to adhere to a larger percentage of first-class ties than the timber will naturally make. It is the same if an engineer insists that if a tie overruns in length two inches and makes his track look a little ragged it is to be treated as a reject, and he is thereby advancing the price of ties both for to-day and the future and wasting the stockholders' money purely for sake of appearance.

The engineer who buys all sizes of ties as they come and finds a use for them, who does not reject ties for minor defects which do not affect their strength and durability, will get his ties cheaper, will aid in conserving the supply, and keep down prices in the future.

WORK OF THE COMMITTEE ON BUILDINGS.

The work of the Committee on Buildings should be most carefully considered before positive recommendations are adopted as to any particular type of construction. While this statement applies to all committee work, it is particularly important in the actions of the Committee on Buildings, because most chief engineers on railways having no bridge and building department have been too busy in other lines of construction and maintenance to study thoroughly the building problem.

On the two most important topics assigned to this committee for report at this convention, progress reports only are presented, which contain much valuable information. The first of these topics, which, by the way, has been under consideration by the committee for two years, is the "investigation of reinforced concrete coaling stations." In the report as presented are several photographic reproductions of some of the best designs already built, which will no doubt be of interest to those contemplating the erection of new coaling plants. We feel that the committee might have safely gone a little farther than it did in this report, and might have recommended the adoption by the larger roads of this type of coaling station for experimental purposes with the specific advice that each railway whose size and finances warrant the expenditure build at least one experimental plant.

One difficulty evidently encountered by the committee is the inability of proving to the satisfaction of the engineering department alone the economy of reinforced concrete coaling stations. Leaving the fire loss, with the incidental extra expense to the operating department, out of the problem, the reinforced concrete type of coaling station is undoubtedly not economical compared with the customary timber construction. The incidental losses in operating due to a loss by fire of the coaling station of an important terminal are not charged to the engineering department and can be only with some difficulty separated from other operating costs, yet every operating man who has experienced such a fire loss knows that the cost is high and that such an accident is most aggravating and demoralizing to the department. Such a one would, had he the authority, do as a chief engineer of one of our largest systems has recently done, put in a reinforced concrete coaling station. This engineer, when asked if he believed it to be economical, said, "I could not prove it by figures, but I recommended it; the management authorized it; I built it and have had no reason to regret it."

The chief engineer of another large railway recently stated that he had secured the authority and was about to build some coaling stations of this type. Thus there is a strong tendency toward building reinforced concrete coaling stations at important terminals, on the broad grounds that, regardless of cost, a railway cannot afford to risk the temporary paralysis of its operating department through a fire loss.

The second topic on which the committee presents a progress report is that of "roof coverings." The committee discusses at some length various "ready roofings," but gives most of its attention to the built-up roofs of felt made waterproof by coal tar pitch, asphalt or similar preparations, the final protective coating being gravel, chat or screenings.

One of the difficulties in learning how to put on a good roof covering is the inability to obtain from the roofing felt manufacturers reliable information as to what their felt is made of and what really constitutes a good felt. It has been conclusively shown that 80 per cent. of some so-called wool felts is wood pulp and that the remaining 20 per cent. is largely cotton rags. As neither the wood

pulp nor the cotton are good absorbents of the waterproofing materials, it would seem that the average roofing felt is about as reliable a product as the shoddy of the Hester street merchant, which he proclaims is "all wool and a yard wide."

It seems to us that the committee has acted wisely in making no hasty recommendations in this matter of roof coverings. Further investigation and study of the question, it is to be hoped, will enable the committee to give the association and the engineering profession generally, information by which an engineer may be surely guided in testing the materials recommended for roof coverings to determine whether they are really good and durable. At the present time most engineers and architects are taking their roofings on faith and the guarantee of the manufacturer.

ECONOMICS OF RAILWAY LOCATION.

The report of this committee for this year was devoted to a discussion of power and resistence, since these are two fundamental elements on which all questions of economics depend. The locomotive tests made at the St. Louis Exposition have furnished much authoritative information. A portion of the report is a discussion and digestion of the figures obtained during these tests. Several tables have been compiled from which to determine the tractive power of locomotives. Table No. 1 gives the average evaporation in locomotive boilers burning bituminous and similar coals of various qualities and for various quantities consumed per square foot of heating surface per hour. Tables 2 to 5 give in regular order the various figures which must be used to obtain finally in Table 6 the tractive power of a locomotive of almost any given type, burning any given quality of fuel, and running at any given velocity.

The discussion of freight train resistance is startling in that it departs so radically from the formulas which have become classic. Until within a few years train resistance was assumed to vary with the square of the velocity. More recently formulas have been proposed involving at least one term varying with the first power of the velocity. The most recent and most reliable tests of heavy freight train resistances on modern track show that the resistance may be represented by a formula which is independent of velocity within the velocities of seven and thirty-five miles per hour. The formula recommended is

$$R = 2.22\ T + 121.6\ C,$$

in which R is the resistence on a level tangent, T is the tonnage of the cars and C is their number. As a very condensed explanation of the validity of a formula which is independent of velocity, it may be said that some elements of train resistance, notably journal friction, actually decrease with a moderate increase in velocity and this decrease neutralizes the increase due to atmospheric resistance. At the very high speeds of passenger express trains the atmospheric resistance is so great that the total resistance increases very materially with the velocity. It is conceded that the constants in the above formula will not be applicable to all cases, but it may be safely applied in comparing freight train ratings on different lines and grades.

The effect of temperature on hauling capacity is also tabulated, showing that the effect is proportionately insignificant when the grade is high (over one per cent,) but is of great importance on very low ruling grades.

An investigation of curve resistance has brought out the fact that the unbalanced centrifugal force, developed on a curve when the train is run at a speed either lower or higher than that for which the track is super-elevated, varies as the square of the degree of curvature. The conclusion is drawn that the elimination of one degree of central angle has a greater value on sharp curves than on easy curves and also a greater value for high-speed than for low-speed traffic. As a general figure, the use of 0.035 per cent. per degree of curve is recommended as the proper rate of curve compensation on grades, the large majority of replies received from members indicating that 0.03 per cent. is too low and that 0.04 per cent. is too high.

LIMIT GAGES FOR RAIL AND FROG WEAR.

The railway mechanical associations have for a long time maintained standard gages and limits for the wear of wheels and axles. The rules define not only the limits of wear of wheel flanges of locomotives and cars as affecting the track gage, but also the shape of the worn flange when it is condemned. These gages and limits have been repeatedly revised, and are kept up to the requirements of changing service conditions. When derailments or wrecks occur there is usually careful inspection by standard gages to ascertain if the limits of wear have been exceeded, and the usual attitude of the inspector is that if there is anything wrong with the gage it must be found at the wheel flange.

The track also is subject to constant inspection, especially as to the wear of rails on curves and at switches, frogs and cross-overs. While the track is kept to gage, no standard limits have been established for the wear of rail or of frogs; that is, the gage inspection does not take account of the shape of the worn rail, and there are no limits which define when a frog is worn out. The books of rules for the maintenance of way of some of the largest railways contain careful instructions in regard to the inspection of frogs and switches, but there is no mention whatever of any limits or limit gages upon which any accurate or intelligent inspection is to be based. One of these rules in a recently revised official book reads as follows: "Section foremen must personally inspect all main track switches once each day, or have some reliable and competent man do so. Track men in making their inspection of switches should pay particular attention to line and gage, worn points, guard rails secure and in true gage, position springs of frogs at proper tension, and that the points of all switches fit squarely against the main rail." The Maintenance of Way rules governing track foremen are as follows: "Track foremen shall be responsible for the proper inspection and safe condition of the track and roadway under their charge, and shall do no work thereon that will interfere with the safe passage of trains, except under proper protection. They must go over their sections, or send a reliable man, with suitable tools, at least once a day to make a thorough inspection, to see that the track, highway crossings, signals, culverts, bridges, fences, telegraph lines, etc., are in safe condition."

These rules indicate very clearly the importance of constant inspection, but they do not define in any way when the rails and points have become worn so they are dangerous and require renewal. They reach that condition some time, and while the judgment of the track men in general must be very good to have served this purpose without resort to exact measurement or definite description or the use of limit gages, yet it is easy to conceive that there are in the main lines of many roads frogs and switches and rails worn on curves which some section foreman would condemn as dangerous, while others might regard them as fit for further service. These decisions would naturally depend to some extent upon the amount of money appropriated for the maintenance of track, and the degree to which a high standard was enforced. Wheels and axles can be inspected and renewed in detail without

interfering with traffic, but the renewal of frogs and switches and main line rail interrupts business and is only resorted to when absolutely necessary, and there is thus a tendency to keep worn track in service longer than it should be. Even in yards the frogs become so badly worn that heavy engines are frequently derailed, but the frogs remain until conditions become so bad that renewal is enforced for the general good of the service. Rail on curves becomes worn at an angle of about 60 degrees, with the horizontal, which materially reduces the width of the top of the head, while the bottom is nearly the original width. The track gage takes no account of this diagonal wear, but standard gage is maintained by measurement across the widest part of the head, while the shape of the head may be such as would induce derailment. What should be the limits of such wear?

The points of frogs become battered down and made blunt to an uncertain degree, and they finally reach a condition where some track man says they should be renewed. Some other track man might have condemned a frog point weeks before it caused a derailment and another man might say it could remain a few weeks longer. What should be the limits of wear of frog points in main track which determine when it is safe and when it is dangerous? The fact that no such limits for rail or frog wear have been established by any of the railways, as far as we know, or by the Maintenance of Way Association, may be taken as evidence that they are not necessary, but when there is so general a complaint that railway accidents are due to carelessness and the faithful old Irish section foreman is disappearing, it would seem that it will soon be necessary to resort to more exact methods of track inspection and that limits of wear will be fixed and limit gages for measuring that wear will be found advisable for conditions about as we have here outlined.

MODERN RAIL MANUFACTURE.

It was generally expected that the discussion on the new rail specification would be one of unusual interest, but it was soon apparent that it was the desire of the committee that little or no change be made in it and that it be allowed to stand as it is, on trial, during the coming year, and that necessary or desirable changes be included in the report next year. The points which were discussed at length were the comparatively unimportant ones relating to surface defects and loading, but the really critical items in the specification, relating to the shearing of the bloom and testing nicked specimens under the drop to destruction, were not taken up.

It is probable that these matters were discussed at the joint meetings of the railway engineers and the steel manufacturers, and it remains to be seen how far the new specification can be enforced in the manufacture of rails during the coming year.

The paragraph relating to the shearing of ingots until the entire face shows sound metal leaves the question of discord about as indefinite as before. It implies that ingots of irregular quality are still expected and that the method of securing sound metal by shearing is still indefinite and uncertain. The new specification requires that test pieces which do not break under the first drop shall be nicked and tested to destruction, and this we regard as probably the most important change, as its strict enforcement would require radical changes in methods of steel manufacture which are scarcely realized. It is this clause which manufacturers have most strenuously objected to, as it is sure to reduce the rate of tonnage output, either by requiring slower methods in both steel works and the rail mill, or by causing a heavy rejection of rails on account of pipes and other internal defects due to unsound steel.

The enforcement by one railway of a clause requiring all drop test pieces to be broken so the fracture could be examined, resulted in the rejection of over 30 per cent. of the rails, and the mills cannot continue in operation under present conditions if all roads attempt to enforce such a method of inspection.

If the steel works and rail mills have made such improvements in their methods as would enable them to operate at a satisfactory profit and make rails which will pass the new specification when rigidly enforced, we are glad of it, but such changes have not been loudly chronicled. Our impression is that the changes in modern rail manufacture are in the other direction, tending to faster rolling and greater tonnage rate per hour.

WOOD PRESERVATION.

An increasing number of roads have resorted to wood preservation as a means of increasing the life of ties and decreasing maintenance of way expenses. The amount of saving can only be calculated approximately and many of the important problems in the art of wood preservation and in the use of preserved wood have yet to be settled. However, the uncertainty of a future tie supply and the certainty of a considerable economy has governed the decision to use preserved wood.

With the critical attention of engineers now fixed on wood preservation, we may expect the art to be advanced and put on a more rational and scientific basis. We believe that hitherto the process of wood preservation has not been attended with the scientific scrutiny of methods and results that will obtain in the future, when increasing demands of specifications and more rigid regulations for inspection will force the wood preservers to study the results which are attained and to correct defects.

Some of the uncovered problems in wood preservation may be suggested. As between zinc chloride and creosote, the advocates of the use of creosote in the past have had the better of the argument. But it is becoming evident that the leaching out of the zinc chloride, which substance is admitted to be an effective and cheap preservative, has been unduly magnified. The volatilization of the lighter fractions of the creosote is becoming evident. Recently insistence has been upon the heavy fractions of the oil that are permanent rather than the lighter fractions.

Another fundamental problem is as to the amount of creosote that needs to be injected in ties. Practice varies anywhere from 6 to 12 lbs. of creosote per cubic foot. This problem is related to the mechanical life of the tie and to the first cost of the tie. It is one of economics. The amount of creosote should be sufficient to preserve the tie for a period equaling its mechanical life, and the use of light creosote treatments, such as the Rueping or Lowry processes, base their belief on the principle that it is not an economy to protect the tie chemically for 25 years, when its mechanical life is limited to 12 years under our present track fastenings.

The future supply of creosote oil is another matter of interest. This creosote oil, which is the by-product of the coal tar industry, is controlled by the use to which the other by-products may be put. In Germany, the hard pitch is used for making briquettes and the heavier portions of the oil appear in the creosote, while in this country comparatively soft pitch is needed for roofing purposes and the creosote oils are not so heavy. Recently the advent of the automobile has torn up the service of our old macadam roads and demanded a new type of construction in which the surface of the road is bound together by a

pitch. The indications are that this is forcing larger supplies of creosote on the market. Again the increased use of the by-product coke oven adds to the supply of creosote.

Coming to the treating process itself, we may note the progress toward the use of seasoned timber, as reflected in the specifications proposed by the Committee on Wood Preservation. It is apparently cheaper and better to season the wood in the air than to attempt to open the passages by slow steaming of green ties in the cylinder. Of course, exigencies of the market may force the treatment of green wood.

With the increased demands of inspection, it is apparent also that more uniform results must be obtained. Wood has great inherent variability. We must expect that individual absorption by individual ties must vary considerably from the average absorption that is specified. The aim must be, however, to reduce this variation. In other words, the ties that go in the cylinder must be uniform. It appears that little is known of the proper grouping of ties, especially in the case of hard woods. Practice and opinions differ largely.

Coming to the method of injection, we find a wide number of different sequences of the application of the various elements, namely, vacuum, hot air, pressure, and temperature of preservative. The object, of course, is to obtain the greatest degree of penetration with the smallest amount of creosote that is safe to use. We are dealing, in the case of creosote, with two fields of knowledge, about which the average man knows but little, and concerning which the experts themselves are apparently very much at sea, namely, the physical laws that control the passage of air and fluids through the wood structure, and the properties and manufacture of coal tar. Indeed it may be said that the whole theory of wood preservation is apparently unsettled. We are led to believe that the antiseptic elements of the coal tar are the least important, but that the waterproofing elements are most effective. It is said that the crude petroleum oils with an asphalt base, in which there is no antiseptic, are effective in preserving woods.

With reference to the preservatives again, the value of the oil from water gas tars, which are produced in such large quantities and which are supposed to form a source of supply of creosote oil, is yet to be determined.

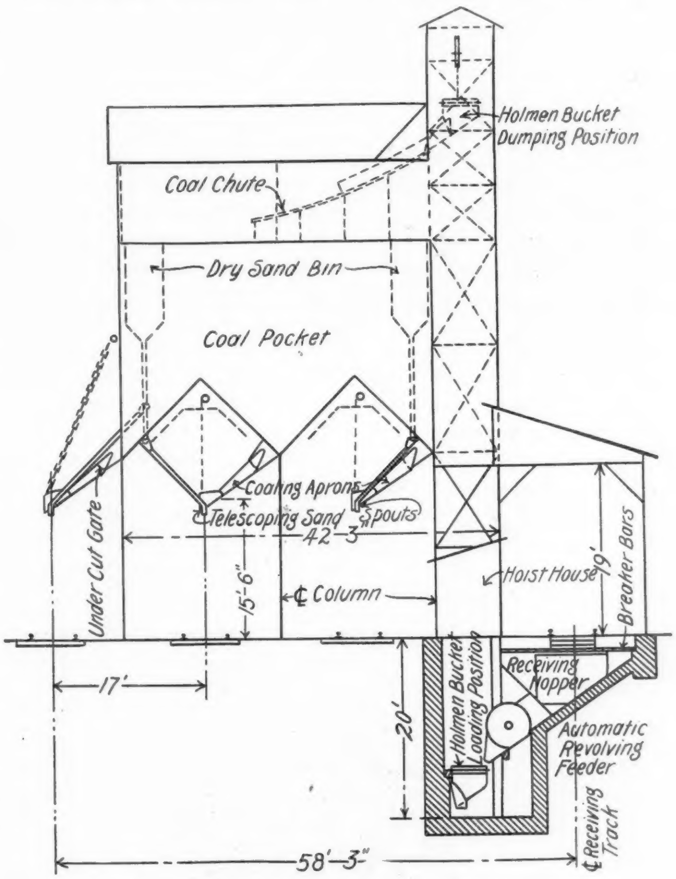
Summing up, it may be said that continued and more extended use of wood preservation may be expected and that thereby the tie renewals in this country should be cut down from the present of 130 million to less than 80 million in the progress of the next 10 years; that we have yet to learn the best method of making use of preserved ties by mechanical protection in the track; that the relative merits of creosote and zinc chloride are yet to be determined; that the relative value of coal tar and petroleum tar as a basis for creosote is yet to be determined; that creosoting of woods and the sequence of operations in the cylinder must be elucidated by a large amount or scientific study. After all, arguments which are based on traditions and on theoretical relations which are not ascertained, must receive final answer in statistics of service. These are beginning to be available, and will be of greatest value if the committees of association will gather together the accurate records of tie renewals in an impartial manner.

The Committee on Wood Preservation makes its second report this year. The chief work of the committee has been the revision of the former specifications for tie treatment. The report of the inspection of the Texas track exhibits the difference in life between ties adequately and inadequately treated. The growth on the industry may be judged by the list of treating plants. The report on the strength of treated timber is a most important contribution to this subject in that all experiments of record have been analyzed and conclusions drawn from the results. The committee has contributed a body of scientific data and experiments that will aid in the interpretation of known facts and aid in the building of a scientific substructure upon which a future improved practice may be built.

A CONCRETE LOCOMOTIVE COALING STATION.

The coaling station now under construction at Corning, N. Y., on the line of the New York Central, is a good illustration of the use of reinforced concrete for this type of structure. The foundations and the entire superstructure, including the storage pockets, elevator housing, engine house, etc., are entirely of concrete, properly reinforced with steel. The structure is therefore entirely fireproof and permanent in construction.

The storage pockets span two railway tracks and are



Elevation of Holmen Coaling Station.

arranged to coal locomotives on both these tracks beneath the pockets and on one track outside the pockets; the receiving track and receiving hopper being on the opposite side of the station from the latter track. The storage capacity of the pockets is 300 tons of coal, besides containing two dry sand bins of 190 cu. ft. each.

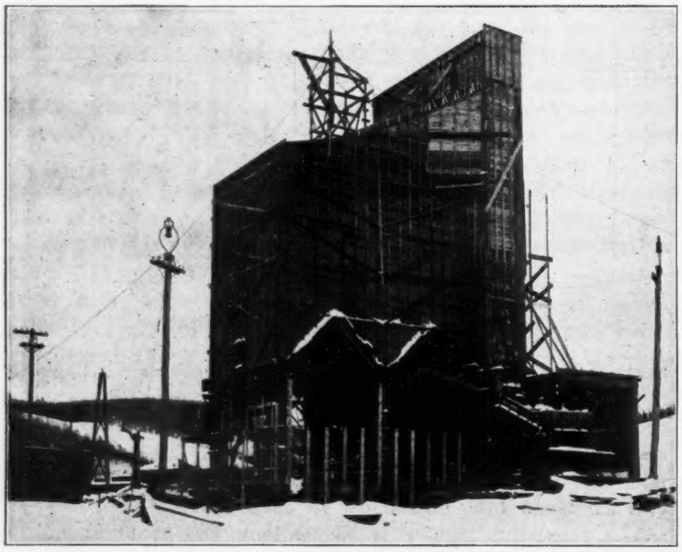
The receiving hopper is 40 ft. long and is arranged to supply coal to two independent hoisting outfits, each consisting of a pair of Holmen balanced bucket elevators, together with a pair of automatic revolving feeders. The hoisting capacity of each outfit is 120 tons per hour. The balanced buckets are connected directly by cable to the reversible hoist in the engine room, and in connection with the automatic revolving feeders constitute practically an automatic hoisting apparatus. The driving power for each set of hoisting equipment consists of a 20 h.-p. motor.

The coal is elevated by the Holmen balanced bucket to a point about 55 ft. above the base of rail, where it is dumped on curved chutes and is lowered into the coal pockets.

The receiving hopper is covered with ¾ in. x 4 in. steel breaker bars, spaced 15 in. centers in both directions, thus enabling the operator to convert mine run coal into locomotive coal of this size. The bottom and all sloping surfaces of the receiving hopper, as well as the bottoms of all the overhead coal pockets, are finished with 1 in. coat of neat cement.

The coaling fixtures consists of three sets of standard balanced hooded aprons complete with heavy steel undercut gates. On each coaling track there is also one set of sand fixtures complete with undercut valves, and telescoping spouts. The dry sand supply is piped to the storage bins in the coal pockets from the adjacent sand drying house, being driven up into the sand bins by compressed air in the usual manner.

The plant is provided with complete steam heating and electric lighting. The outlet gates in the bottom of the storage pockets are steam jacketed to prevent the coal freezing at these points during cold weather. Special heating coils are also provided in the motor house and in the receiving hopper where the coal is delivered into the revolving feeders to prevent the coal freezing at those points. The dry sand bins are also each provided with steam coils.



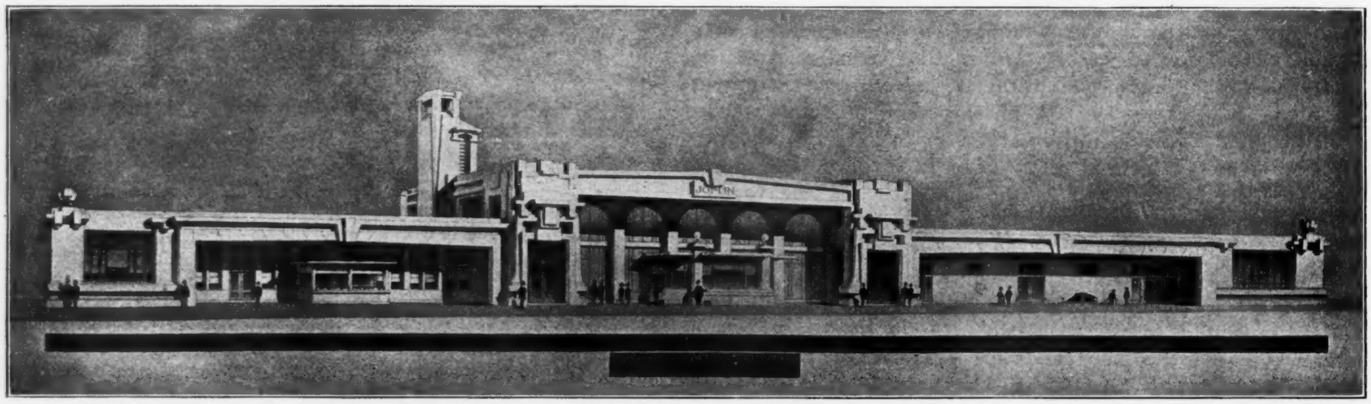
Holmen Concrete Coaling Station.

The plant is also provided with complete electric signal equipment, including safety limit switches to prevent overwinding in the operation of the elevator buckets. The electric current both for lighting and power is taken from the railway company's three phase, 60 cycle, 440 volt current.

This station was designed and built by the Roberts and Schaefer Company, consulting engineers and contractors of Chicago, under the supervision of G. W. Kittredge, chief engineer of the New York Central and Hudson River Railroad.

JOPLIN UNION STATION.

The accompanying illustration shows the track side of the proposed Union station to be built at Joplin, Mo., for the Kansas City Southern, the Atchison, Topeka & Santa Fe, the Missouri & North Arkansas and the Missouri, Kansas & Texas. The Santa Fe at present comes into Joplin over the Kansas City Southern tracks. It is not yet decided exactly how the other two roads will make their connections.



Joplin Union Station.

The general waiting room is in the center of the building. The ticket office projects out toward the track from the wall of the waiting room, as shown, but is under the projecting roof. The wing at the left, in the view herewith, contains the restaurant, and the other wing contains the baggage, mail and express rooms. The present plans are subject to a number of modifications, and the floor plan of the station has not yet been fully worked out. For instance, the news stand shown in front of the left wing will, instead, be put inside the station in the general waiting room.

The building will be either of reinforced concrete or partially of steel frame construction encased with concrete. The exterior will be finished in either limestone or white tile.

BUSH TRAIN SHED AT CHICAGO.

The Bush train shed being built for the Chicago & Northwestern's new passenger station in Chicago was fully described in the Railway Age Gazette of July 16, 1909. The erection of the steel for the shed has progressed very satisfactorily and the accompanying photographs taken March 11 show about one-third of the structure in place.

As was explained in the previous article on this shed, the design differs from the two similar sheds which have been built, in that it is on an elevated structure. The shed columns are carried through the platform and riveted to the girders which support the entire structure.

In designing this station, the engineering and operating departments of the Northwestern considered carefully the relative advantages of locating the columns on the center line between the tracks and on the center line of the platforms. With the columns located on the platforms, the smoke ducts come at the high point of the shed roof, which prevents the possibility of any gases following along the steel work. The

BUSH TRAIN SHED
In Course of Erection—Interior View.

BUSH TRAIN SHED
In Course of Erection—View from Above.

smoke ducts, which are 5 ft. and 3¾ in. high, project about 18 in. above the roof so as to have their tops as high as the roof ridge; and extend downward directly over the engine smoke stacks, thus preventing down drafts of gas and smoke into the train shed. If the columns were located on the center line between tracks, the smoke ducts would be at the low point of the shed and would have to be of greater height to bring their tops flush with the roof ridge and the entire shed would necessarily be of greater height, and cost more. It was also considered essential to provide skylights over the center line between tracks, in order to furnish light to the sides of the cars farthest from the platforms. This would have been impossible with the columns between the tracks, as the gutters are necessarily at the low part of the shed roof and any accumulation of snow or water would naturally lodge at this point.

When located on the platforms the columns do not occupy more than 12 in. of width per pair of tracks, which is about 2½ ft. less than they would require if located between the tracks, and which, in turn, would have to be spread for proper clearance. With tracks spaced 12½ ft. center to center, the clear distance between passenger cars is practically 2½ ft. a recognized safe clearance, and permits sufficient room for car cleaners to clean coaches and car windows within the shed. With the columns between the tracks, in order to provide the same relative clearance and room, the track centers would have to be 16 ft. apart, allowing one foot for the column and 2½ ft. clearance either side of it. This is an important item where the real estate for a new terminal site is very valuable.

It was also found from observations made in the rush hours at the Hoboken terminal where the train shed columns are located on the center lines of platforms, that when one train is discharging passengers on one side of a platform, and another train receiving passengers on the opposite side of the same platform, that the column facilitated the movements, the lines of travel in opposite directions dividing themselves naturally on each half of the platform.

The Bush shed is patented by Lincoln Bush, E. D. 1 Madison avenue, New York City. Mr. Bush was chief engineer of the Lackawanna at the time of building his type of shed at Hoboken and Scranton.

ECONOMICS OF RAILWAY LOCATION.*

There are two fundamental points: Power and resistance. In many different practical tests variations in results have occurred, owing to differences in standards of maintenance of track and equipment, and differences in details of construction of equipment. Exact rules for determining the power and resistances, which will apply in all cases, cannot be deduced; but approximations can be made of sufficient practical value when applied for the purposes intended.

Power.

Where actual tests have been made under the prevailing local conditions, the problem is simple, as the actual available power for various speeds should be used. Where such tests have not been made the problem is more complex.

The report goes fully into the theoretical rating of locomotives and develops the accompanying tables.

Appendix A shows a number of diagrams of calculated drawbar pull on the basis outlined herein and actual recorded drawbar pull reduced to level grade at maintained velocities. [They show, with various kinds of locomotives, excesses of from 1,400 to 2,700 pounds of cylinder tractive power over actual drawbar pull.] It may be claimed that the calculated pull varies too much from actual results obtained, but it will be impossible to devise a formula that will come much nearer the actual results than the proposed method, with the meager information at hand with reference to the exact effect of each detail of locomotive on tractive power, and were information available, the method of calculation would be very complex.

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

The committee recommends that the following conclusions and tables mentioned therein be adopted for publication in the Manual, with a view to furnishing a reasonable and logical method of determining the available power of any given locomotive, it being distinctly understood that as further research and data are secured the tables and rules can be changed when considered advisable.

Conclusions and Recommendations.

(1) Actual drawbar pull of the locomotive at various speeds should be used in making estimates with reference to economic value of various locations of line and grade, where such drawbar pull is known. Where not known, the drawbar pull should be calculated. In comparing a new line with an existing line, the same percentage of efficiency of drawbar pull should be used in both cases.

(2) The tractive power of a locomotive depends on its steam-producing capacity, the boiler pressure, the adhesion and the size of the cylinders and drivers.

(3) The steam-producing capacity of a locomotive depends mainly upon the quantity and quality of the fuel burned, the amount of heating surface and the ratio of heating surface to grate area.

TABLE No. 1.

AVERAGE HOURLY EVAPORATION PER 1000 FT. OF HEATING SURFACE FOR VARIOUS RATIOS OF HEATING SURFACE TO GRATE AREA AND FOR VARIOUS RATES OF FUEL CONSUMPTION BASED ON USE OF BITUMINOUS COAL TESTING 15000 B.T.U. PER POUND.

Ratio	Lbs. Coal per Sq. Ft. Grate Area per Hour										
	60	70	80	90	100	110	120	130	140	150	160
R-50	8136	8965	9690	10324	10879	11365	11790	12162	12487	12771	13020
R-55	7697	8480	9165	9764	10288	10747	11149	11501	11809	12079	12314
R-60	7295	8037	8686	9254	9751	10186	10567	10900	11191	11446	11669
R-65	6913	7617	8233	8772	9244	9657	10018	10334	10610	10852	11064
R-70	6566	7234	7818	8329	8776	9167	9509	9808	10070	10299	10500
R-75	6238	6874	7430	7917	8343	8716	9042	9327	9576	9794	9985
R-80	5939	6542	7070	7532	7936	8289	8598	8868	9104	9311	9492
R-85	5677	6255	6761	7204	7591	7930	8227	8487	8714	8912	9085
R-90	5440	5993	6477	6900	7270	7594	7878	8126	8343	8533	8699
R-95	5211	5741	6205	6611	6966	7277	7549	7787	7995	8177	8336

ABOVE TABLE ASSUMES FEED WATER AT AVERAGE OF 60° F. AND BOILER PRESSURE 200 LBS. FOR 160 POUNDS BOILER PRESSURE APPROXIMATELY ONE HALF PER CENT GREATER QUANTITY WOULD BE EVAPORATED.

FOR COAL OF DIFFERENT THERMAL VALUE THAN 15000 B.T.U. MULTIPLY TABULAR AMOUNTS BY FOLLOWING DECIMALS:

14500 B.T.U.	0.967	12000 B.T.U.	0.80
14000 "	0.933	11500 "	0.767
13500 "	0.900	11000 "	0.733
13000 "	0.867	10500 "	0.70
12500 "	0.833	10000 "	0.667

(4) Knowing the areas of grate and heating surface, the average steam production of locomotives burning bituminous and similar coals can be estimated by the use of Table No. 1, assuming 4,000 pounds of coal as the maximum quantity that can be properly "fired" per hour.

(5) The maximum velocity at which full cut-off can be maintained can be found by dividing the pounds steam produced per minute by the quantity of steam used per revolution of the drivers, as shown in Table No. 2. Dividing this quotient by the coefficient given in Table No. 3 for the diameter of the drivers will give the speed in miles per hour at which full cut-off can be maintained. This velocity is referred to as "M" in the tables. [Table No. 3 is not reproduced herewith. It is derived from the formula: $C = \frac{336.13}{\text{Diam. of drivers in inches}}$.]

(6) Tractive power of a locomotive is greatest at starting, gradually reducing to the maximum velocity ("M") at which full cut-off can be maintained. At speeds above this

velocity the tractive power decreases more rapidly. The tractive power at any multiple of "M" is practically a fixed percentage of the tractive power at "M." The fixed percentages are different for compound types than for simple locomotives.

(7) Knowing the steam production of a locomotive and the maximum velocity at which full cut-off can be maintained ("M"), the indicated horsepower of the locomotive can be obtained for velocity "M" or higher velocities by dividing the total steam produced per hour by the quantity of steam used per I.HP. hour, as given in Table No. 4, after applying the corrections for proper boiler pressure.

(8) Horsepower can be converted into tractive power by the formula, tractive power equals 375 times the horsepower, divided by the velocity in miles per hour. To simplify the operation, the tractive power can be obtained by multiplying the horsepower by the figures shown in Table No. 6. [The table is not reproduced herewith.]

(9) Where I.HP. at "M" velocity has been converted into cylinder tractive power, the cylinder tractive power at other multiples of "M" can be determined by using the percentages given in Table No. 5 without first calculating the I.HP. for the respective multiples of M.

(10) Available drawbar pull on level tangent is the cylinder tractive power, less the sum of the resistances from the cylinder to the rim of drivers, the resistance through the trucks of engine and tender, and the "head end" or velocity resistance. The formulas and data given in Table No. 7 are recommended for use in determining these resistances. Available drawbar pull at starting, with use of sand, should not usually be considered as greater than 30 per cent. of the weight on locomotive drivers, and at running speeds not greater than 25 per cent.

Train Resistance and Curve Resistance.

While it is impossible to deduce rules for absolute freight tonnage rating between speeds of 7 to 35 miles per hour, owing to variables which must be allowed for at the beginning of each trip, it is feasible to make a formula which will be sufficiently accurate for purposes of comparing locations, and one which may be used as a base to which corrections may be applied.

As is well understood, corrections must be applied for:

(1) Temperature (always allowed for).

(2) Condition of equipment.

(3) Amount and character of curvature. (Allowed for by adding to ruling grade if uncompensated.)

(4) Condition of roadbed, i. e., class of maintenance. (An important consideration not taken into account as it should be.)

(5) Local conditions, such as short passing sidings or limited facilities, which would curtail the length of a train.

(6) Length of grade. (Grades over five miles in length will cause reduction of trainload with coal-burning engines.)

(7) Kind of fuel. (For instance, with oil fuel, engines will accelerate on long ruling grades, where, with coal, they might not haul their rating.)

(8) Efficiency of operatives.

(1) Formula of A. C. Dennis:

Under date of August, 1909 (Bulletin No. 114), Mr. Dennis produced a formula

$$R = 2.6\,t + 85\,n$$

where t = tonnage of cars in train, and n = number of cars.

A ittle closer working of his data gives $R = 2.41\,t + 89.6\,n$.

The cases cited show a remarkable uniformity, which would indicate that the conditions under which the results were attained were about the same. The cars were all box cars.

(2) Baltimore & Ohio Tests:

In April, 1904, certain tests were made on the Baltimore & Ohio with coal hoppers, which were conducted under such satisfactory conditions as to make some conclusions of value. J. R. Onderdonk, engineer of tests, conducted these tests. The accompanying record shows the data of some of the tests.

From the foregoing tests it would appear that, on the class of line that is covered by the tests, coal hoppers need a higher factor than box cars. In the eastern part of the United States, especially among the mountains, alignment is crooked, and even if curvature is compensated, long trains often get on two or more curves at once, with the result that compensation is not sufficient to offset the fact that the trucks do not straighten themselves out in accordance with the theory that they should do so. The result is a greater resistance than would be shown on a uniformly straight line. This fact may account for the high unit resistance shown on these tests.

Based on a large number of tests made on the Baltimore & Ohio in 1904, a formula was evolved which has since been used by that road. When reduced to a form equivalent to Mr. Dennis', it is:

$$R = 2.78\,t + 113.9\,n$$

This formula has been found to meet working conditions fairly well when corrected to meet local peculiarities—temperature, etc. It would, however, call for a lower adjustment per car than the formula $R = 2.68\,t + 143.8\,n$, and accordingly would call for a higher rate of correction to meet local conditions.

Following is an exposition of the formula with corrections for temperature and adjustments in tons per car:

DATE	April, 1904 Constant Speed	April, 1904 Constant Speed	May, 1906 Constant Speed	April, 1904 Constant Speed	April, 1904 Constant Speed
Speed	10 M.P.H.	10 M.P.H.	6.5 M.P.H.	15 M.P.H.	15 M.P.H.
Engine	2343	2343	2646	2343-1821-1403	2343
Location	North Mntn. Cut-off	North Mntn. Cut-off	Mt. Airy Hill	Mt. Airy Hill	Adamstown Cut-off
Grade	3%	.3%	85%	85%	30%
Curvature	Max. 4°	Max. 4°	2° 30′	Tangent	Tangent
Track	Good—Rock Ballast	Good—Rock Ballast	Fair—Cinder Ballast	Fair—Cinder Ballast	Fair—Cinder Ballast
Rail	85 lb.	85 lb.	85 lb.	85 lb.	85 lb.
Compensated	.03	.03	03	....	....
Number of cars	38	38	26	32	32
Kind of Cars	36 loaded Coal Hoppers	36 empty Coal Hoppers	24 Coal Hoppers	30 loaded Coal Hoppers	30 loaded Coal Hoppers
Weight of Cars	687.5 tons	687.5 tons	468.0 tons	582 tons	582 tons
Caboose	9.5 tons	9.5 tons	9.5 tons	9.5 tons	9.5 tons
Dynamometer Car	17 tons	17 tons	17 tons	17 tons	17 tons
Total Number of Cars	38	38	26	32	32
Total Tonnage	2533	714	1513	2113	2113
Resistance by Dynamometer	27195	11504	34630	45600	23100
Resistance on level	12000	7220	8531	9679	10422
Formula deduced	......	......	R = 2.68t + 143.8n*	......	......
Resistance in lbs. per ton	4.73	10.11	5.64	4.58	4.92

RECORDS OF DYNAMOMETER TESTS.

System to Determine Rating for Locomotives.

Let P = Pulling power of locomotive (lbs.).
E = Weight of engine and tender (lbs.).
W = Weight of train (lbs.).
R = Rate of grade (tangent of angle).
K = Function of W (resistance).
N = Number of cars.
C = Function of N (resistance).
and A = Rating.

Then as the general formula for train resistance

$$P = (E + W)\,(R + K) + N\,C \qquad (1)$$

$$\frac{P}{R + K} - E = W + N\left[\frac{C}{R + K}\right]$$

$$\text{but } W + N\left[\frac{C}{R + K}\right] = A \qquad (2)$$

$$\text{Therefore } \frac{P}{R + K} - E = A \qquad (3)$$

To Determine Value of K.

$$\text{Let } \frac{P}{R' + K} - E = A' \text{ and } \frac{P}{R'' + K} - E = A''$$

Then $P = (A' + E)\,(R' + K)$ and $P - (A'' + E)\,(R'' + K)$.

Therefore

$$A'R' + A'k + ER' + EK = A''R'' + A''K + ER''EK,$$

from which we get

$$K = \frac{R''(A'' + E) - R'(A' + E)}{A' - A''} \qquad (4)$$

Now by test, using E-24 engine,
When $R' = .003$, $A' = 6{,}970{,}000$ — .3% grade,
and when $R'' = .01$, $A'' = 2{,}480{,}000$ — 1% grade.
Also $E = 336{,}500$ weight of engine and loaded tender.
Substituting values for A', A'', R', R'', and E, we get,

$$K = \frac{.01\,(2{,}480{,}000 + 336{,}500) - .003\,(6{,}970{,}000 + 336{,}500)}{6{,}970{,}000 - 2{,}480{,}000}$$

or $K = .00139$ pounds per pound,
$= 2.78$ pounds per ton.

To Determine Value of C.

$$\text{Let } B = \frac{C}{R + K} = \text{adjustment}.$$

By test it is found that five tons is the proper adjustment for 1 per cent. grade, substituting values for B, R, and K,

$$10{,}000 = \frac{C}{.01 + .00139}$$

$$C = 113.9.$$

Example.—To determine adjustment for .3 per cent. grade knowing C and K,

$$B = \frac{C}{R + K}$$

Substituting values for C, R, and K, we get,

$$B = \frac{113-9}{.003 + .00139} = 25{,}945, \text{ or } 13 \text{ tons.}$$

To Determine Value of P for E-24 Engine.

$$\text{We have } A = \frac{P}{R + K} - E,$$

Therefore $P = (A + E)\ (R + K)$
As above when $R = .003$, $A = 6{,}970{,}000$.
. E and K are known.
Substituting we get,

$$P = (6{,}970{,}000 + 336{,}500)\ \ (.003 + .00139)$$

$$P = 32{,}075.$$

To Determine the Rating of E-24 Engine on Various Grades.

We have

$$A = \frac{P}{R + K} - E$$

in which P, K, and E are known, substituting we get,

$$A = \frac{32075}{R + .00139} - 336{,}500$$

For example, to determine rating for a E-24 engine on .3 per cent. grade,

$$A = \frac{32075}{R + .00139} - 336{,}500$$

Substituting value R, we get,

$$A = \frac{32075}{.003 + .00139} - 336{,}500$$

$$A = 6{,}970{,}000$$

$$= 3{,}485 \text{ tons.}$$

Adjustment for Various Grades.

Per cent. of grade.	Adjustment in tons.	Per cent. of grade.	Adjustment in tons.
.3	13	1.0	5
.35	12	1.1	5
.4	11	1.2	4
.45	10	1.3	4
.5	9	1.4	4
.55	8	1.5	3
.6	8	1.6	3
.65	7	1.7	3
.7	7	1.8	3
.75	7	1.9	3
.8	6	2.0	3
.65	6	2.2	2
.9	6	2.4	2
.95	5	2.6	2

The Pennsylvania Railroad formula, as shown in Mr. Cole's article on Train Resistance, Railroad Age Gazette (page 547, Vol. XLVI, No. 13), is as follows:

$$R = 1.0769\,t + 138.46\,n$$

This formula gives a higher rate of adjustment than any of the formulas shown so far. It is based on tests made in 1907, which gave the following results:

Weight of car.	Resistance on level tangents.	Number of tests.
20 tons	8 lbs. per ton	3
72 tons	3 lbs. per ton	15

It should be noted from the article in the Railroad Age Gazette that while resistance per ton increases slowly as weight increases after car passes weight of 60 tons, resistance per ton increases very rapidly as car is lighter than 20 tons. Between these two car weights resistance in pounds per ton is nearly proportional to the weight of car.

As it is out of the question and perhaps a refinement to have special formulas for different classes of cars, the following is recommended as being a combination of the result of Mr. Dennis' and Mr. Shurtleff's investigations, those of the Baltimore & Ohio and the Pennsylvania Railroad, according to the Railroad Age Gazette.

	Resistance of 20-ton car on level tangent.	Resistance of 70-ton car on level tangent.
Dennis and Shurtleff	138	258
Selected tests Balt. & Ohio	197	331
Baltimore & Ohio	169	308
Pennsylvania Railroad	159	213
Average of all	166	277

$$\text{Thus, } 166 = K\,20 + C$$

$$277 = K\,70 + C$$

$$111 = K\,50$$

$$2.22 = K$$

$$121.6 = C$$

Formula recommended: $R = 2.22\,t + 121.6\,c$.

Adjustments in tons per car from the formula:

Grade.	Tons per car.	Grade.	Tons per car.	Grade.	Tons per car.	Grade.	Tons per car.	Grade.	Tons per car.
Level	54	0.4	12	0.8	6.7	1.2	4.6	1.6	3.5
0.1	29	0.5	10	0.9	6.0	1.3	4.3	1.7	3.3
0.2	20	0.6	8.5	1.0	5.4	1.4	4.0	1.8	3.1
0.3	14	0.7	7.5	1.1	5.0	1.5	3.7	1.9	2.9
								2.0	2.8

Per Cent. of Rating to Be Used for Various Temperatures Based on Tests on .3 Per Cent., 1 Per Cent. and 2.6 Per Cent. Grades.

Per cent. of grade.	A Above 45 deg.	B 45 to 35 deg.	C 35 to 20 deg.	D Below 20 deg.
.3	100	88	76	65
.35	100	90	80	69
.4	100	91	82	72
.45	100	91	83	74
.5	100	92	84	76
.55	100	93	86	78
.6	100	93	87	80
.65	100	94	88	82
.7	100	94	88	83
.75	100	95	89	84
.8	100	95	90	85
.85	100	95	90	85
.9	100	95	90	86
.95	100	96	92	87
1.0	100	96	92	88
1.1	100	96	92	89
1.2	100	97	93	90
1.3	100	97	94	91
1.4	100	97	94	91
1.5	100	97	94	92
1.6	100	97	94	92
1.7	100	98	95	93
1.8	100	98	95	93
1.9	100	98	96	94
2.0	100	98	96	94
2.2	100	98	96	95
2.4	100	99	97	96
2.6	100	99	97	96

Starting Resistances.

Starting resistances vary with temperature, loading, condition of equipment and character of roadway maintenance. In pounds per ton, it will vary from 40 to 10. Trains are

started by increments, so that starting resistances rarely become limiting.

Mr. Dennis is probably the first to call attention to the fact that speeds between 7 and 35 m. p. h. show a constant total train resistance, for the same train. Mr. Shurtleff further corroborates with personal experience.

On page 546, Railroad Age Gazette, Vol. 47, No. 13, it is stated that the Pennsylvania Railroad used resistance between 5 and 35 m. p. h. as a constant. Further corroborative evidence is had from dynamometer experiments of the Baltimore & Ohio in 1904. The runs at the higher speeds, over exactly the same track, showed slightly less resistance than those at ten miles per hour. These tests were reliably made, and, like the others, were conducted by Engineer of Tests Onderdonk.

Curve Resistance.

We are interested in curve resistance chiefly from the standpoint of its compensation. In the location of a railway curvature evils may be eliminated partially by reducing gradient on the curve by such an amount as to make the engine effort the same on curve as on tangent.

How much of a reduction shall be made? Under curve resistance it is proper to consider a few subheads:

(a) Resistance of long curves.
(b) Resistance of short curves.
(c) Curve resistance at high speed.
(d) Curve resistance at low speed.
(e) Easements to curves.
(f) Superelevation of curves—which rail, if either, should remain at grade.
(g) Dynamometer tests.

(a) Resistance of long curves.

The resistance to traction of long curves is probably greater than short curves. If the curve is long enough to take the whole train at once, the engine is changing direction at the same time that it is pulling the train. All the trucks in the train are slewed around at the same time.

(b) Resistance of short curves.

In the case of short curves, however, only a part of the trucks are slewed at the same time, and for a proportion of the time the engine is working on straight track while it is pulling the train.

(c) Curve resistance at high speed.

On account of the trucks straightening up better at high speed, it is probable that the effect of curvature is dispelled sooner at high speed than at slow speed.

(d) Resistance at slow speed.

As an example of the way that trucks fail to straighten at slow speed, attention is called to the old single-track bridge on the Baltimore & Ohio over the Susquehanna river.

The traffic is practically 100 per cent. loaded eastbound and about 40 per cent. westbound. At the eastbound approach to the bridge there was a 7 deg. 30 min. curve, running out on the bridge about 400 ft. The speed of eastbound trains at this point was ten miles per hour and the length of the bridge about one and one-eighth miles, leaving over a mile of tangent on the bridge.

The north rail on the bridge (which was the continuation of the high rail of the curve) was badly flange-worn throughout the mile length of the bridge—the first half-mile being as much worn as the high rail of the curve. The north rail also crept much faster than the other, showing the pressure of the flanges.

The above would indicate that curve resistance at slow speed does not stop at the end of the curve.

(e) Superelevation of curves.

The easement to a curve serves the double purpose of an easy approach to the curve and a run-out to the superelevation. It should be noted that, with the inner rail held at grade, the center of gravity of the train must be raised through approximately one-half the superelevation. It would appear as if the logical superelevation would be a call for raising the outer rail by one-half the calculated superelevation. This would mean depressing the inner rail by the same amount. It would seem from a standpoint of resistance that the question should be given consideration. It is already the practice on many of the roads in the United States and Canada.

(f) How much does curve resistance amount to in equivalent grade?

In April of 1904 tests were made on the Baltimore & Ohio Railroad, North Mountain Cut-Off and Mount Airy Grade, to determine the effect of curve compensation. Certain parts of these lines were compensated at the rate of

TABLE No. 2.

WEIGHT OF STEAM USED IN ONE FOOT OF STROKE IN LOCOMOTIVE CYLINDERS

CYLINDER DIAMETER IS FOR HIGH PRESSURE CYLINDERS IN COMPOUND LOCOMOTIVES

DIAMETER OF CYLINDER IN INCHES	WEIGHT OF STEAM PER FOOT STROKE FOR VARIOUS GAGE PRESSURES						
	220 #	210 #	200 #	190 #	180 #	170 #	160 #
12	0.405 Lbs.	0.389 Lbs.	0.370 Lbs.	0.354 Lbs.	0.337 Lbs.	0.321 Lbs.	0.304 Lbs.
13	0.475	0.456	0.435	0.415	0.396	0.376	0.357
14	0.551	0.529	0.504	0.482	0.459	0.436	0.414
15	0.633	0.607	0.579	0.553	0.527	0.501	0.476
15½	0.675	0.649	0.618	0.590	0.562	0.535	0.508
16	0.720	0.691	0.658	0.629	0.599	0.570	0.541
17	0.812	0.780	0.744	0.710	0.676	0.643	0.611
18	0.911	0.875	0.834	0.796	0.759	0.722	0.685
18½	0.962	0.924	0.881	0.841	0.801	0.762	0.724
19	1.015	0.975	0.928	0.887	0.845	0.804	0.763
19½	1.069	1.027	0.978	0.934	0.890	0.847	0.804
20	1.125	1.080	1.029	0.983	0.936	0.891	0.846
20½	1.181	1.134	1.081	1.032	0.984	0.936	0.888
21	1.240	1.191	1.134	1.083	1.032	0.982	0.932
22	1.361	1.307	1.245	1.189	1.133	1.078	1.023
23	1.487	1.428	1.361	1.300	1.238	1.178	1.118
28	2.204	2.117	2.017	1.926	1.835	1.745	1.657

FOR WEIGHT OF STEAM USED PER REVOLUTION OF DRIVERS AT FULL CUT-OFF:-
MULTIPLY THE TABULAR QUANTITY BY FOUR TIMES THE LENGTH OF STROKE IN FEET FOR SIMPLE AND FOUR CYLINDER COMPOUNDS. FOR TWO CYLINDER COMPOUNDS MULTIPLY BY TWO TIMES THE LENGTH OF STROKE

TABLE No. 4.

MAXIMUM CUT-OFF AND POUNDS OF STEAM PER I.H.P. HOUR FOR VARIOUS MULTIPLES OF "M".

"M" = MAXIMUM VELOCITY IN MILES PER HOUR AT FULL CUT-OFF. BOILER PRESSURE, 200 LBS.

VELOCITY	PER CENT CUT-OFF	LBS. STEAM PER I. H. P. HOUR		VELOCITY	PER CENT CUT-OFF	LBS. STEAM PER I. H. P. HOUR	
		SIMPLE LOC.	COMPOUND LOC.			SIMPLE LOC.	COMPOUND LOC.
1.0 "M"	FULL	38.30	25.80	2.9 "M"	38.5	24.37	21.04
1.1	94.4	36.46	24.36	3.0	37.0	24.22	21.21
1.2	89.1	34.89	23.24	3.2	34.2	24.00	21.57
1.3	84.3	33.56	22.35	3.4	31.8	23.85	21.93
1.4	79.7	32.41	21.65	3.6	29.8	23.8	22.27
1.5	75.4	31.40	21.14	3.8	28.0	23.8	22.57
1.6	71.4	30.49	20.77	4.0	26.4	23.87	22.85
1.7	67.7	29.67	20.52	4.25	24.7	24.05	23.22
1.8	64.3	28.93	20.40	4.50	23.3	24.24	23.56
1.9	61.0	28.25	20.40	4.75	22.1	24.44	23.85
2.0	58.0	27.62	20.40	5.00	21.1	24.64	24.15
2.1	55.2	27.05	20.40	5.5	19.5	24.98	24.70
2.2	52.6	26.52	20.40	6.0	18.4	25.20	
2.3	50.1	26.06	20.40	6.5	17.6	25.45	
2.4	47.8	25.67	20.40	7.0	17.1	25.60	
2.5	45.7	25.32	20.47	7.5	16.7	25.70	
2.6	43.7	25.02	20.60	8.0	16.4	25.80	
2.7	41.8	24.76	20.73	9.0	16.1	25.90	
2.8	40.1	24.54	20.88				

FOR STEAM PER I.H.P. HOUR FOR OTHER BOILER PRESSURES TAKE THE FOLLOWING PERCENTAGES OF VALUES GIVEN IN TABLE;

160 Lbs. - 103% 190 Lbs. - 100.6%
170 Lbs. - 102.1% 210 Lbs. - 99.5%
180 Lbs. - 101.3% 220 Lbs. - 99.2%

.03 and other parts at .04. The detailed results showed that on the portion compensated .03 per cent., resistance on curve was greater than on tangent, and on the portion compensated .04 per cent., resistance on curve was less than on tangent. These tests were conducted under the direction of J. R. Onderdonk, engineer of tests, and the results were computed by him.

The consensus of opinion of the replies to a circular put out in 1907 for information on the same subject was that .035 per cent. per degree gave the best results.

Conclusions.

It is recommended that the following conclusions be adopted:

(1) Dynamometer tests to be of the greatest value should show the following:

(a) Dynamometer record (graphical) showing drawbar pull to nearest ten pounds, with horizontal scale not less than 400 ft. to one inch and in special cases a larger scale.

(b) Speed record to nearest tenth of mile per hour (graphical).

TABLE No. 5.

PER CENT CYLINDER TRACTIVE POWER FOR VARIOUS MULTIPLES OF "M"

"M" = MAXIMUM VELOCITY IN MILES PER HOUR AT WHICH BOILER PRESSURE CAN BE MAINTAINED WITH FULL CUT-OFF.

VELOCITY	COMPOUND %	SIMPLE %	VELOCITY	COMPOUND %	SIMPLE %	VELOCITY	COMPOUND %	SIMPLE %
START	(SIMPLE) 133.00	106.00	3.6 M.	32.40	44.75	6.4 M		23.59
0.5 M.	103.00	103.00	3.7	31.25	43.56	6.5		23.18
1.0	100.00	100.00	3.8	30.10	42.39	6.6		22.79
1.1	96.28	95.57	3.9	29.14	41.24	6.7		22.42
1.2	92.55	91.53	4.0	28.24	40.10	6.8		22.06
1.3	88.83	87.83	4.1	27.38	39.00	6.9		21.71
1.4	85.12	84.46	4.2	26.56	37.96	7.0		21.38
1.5	81.40	81.37	4.3	25.77	36.97	7.1		21.06
1.6	77.68	78.55	4.4	25.03	36.03	7.2		20.75
1.7	73.96	75.97	4.5	24.34	35.13	7.3		20.45
1.8	70.25	73.60	4.6	23.69	34.26	7.4		20.16
1.9	66.54	71.41	4.7	23.07	33.41	7.5		19.88
2.0	63.21	69.37	4.8	22.48	32.59	7.6		19.61
2.1	60.20	67.47	4.9	21.92	31.82	7.7		19.34
2.2	57.48	65.67	5.0	21.38	31.11	7.8		19.08
2.3	54.97	63.94	5.1	20.87	30.42	7.9		18.82
2.4	52.68	62.22	5.2	20.37	29.75	8.0		18.57
2.5	50.42	60.55	5.3	19.89	29.10	8.1		18.33
2.6	48.16	58.92	5.4	19.43	28.48	8.2		18.09
2.7	46.08	57.33	5.5	18.99	27.87	8.3		17.86
2.8	44.10	55.78	5.6		27.33	8.4		17.64
2.9	42.29	54.26	5.7		26.81	8.5		17.43
3.0	40.57	52.78	5.8		26.30	8.6		17.22
3.1	38.95	51.35	5.9		25.81	8.7		17.01
3.2	37.42	49.91	6.0		25.34	8.8		16.82
3.3	35.98	48.55	6.1		24.88	8.9		16.63
3.4	34.66	47.24	6.2		24.44	9.0		16.45
3.5	33.53	45.97	6.3		24.01			

(c) Key to record mile posts.

(d) Condition of track surface (graphical).

(e) Steam pressure of boiler (graphical).

(f) Train line air pressure (graphical).

(g) Time record (graphical).

(Speed record may be independent record, and in this case time record is desirable.)

(h) Coal consumption (record of shovels of coal as used) (worked by hand in engine).

Requisite data to be taken:

Track.

(i) Office profile and alinement connecting with mile posts (so as to connect with 3).

(j) Section of rail.

(k) Condition of rail.

(l) Number of ties to rail (and rail length).

(m) Kind of ballast.

Locomotive.

(n) Type (wheel arrangement, whether simple or compound, and dimensions of locomotive).

(o) Total weight and weight on drivers.

Cars.

(p) Record of length, initial, number, class of each car of train, also weight empty and weight loaded.

(q) Kind of truck.

(r) Condition of car.

Weather.

(s) Temperature.

(t) Direction and force of wind and direction of train.

(u) State of weather (rain or clear).

(2) Resistance of freight trains shows practically no change of resistance between 7 and 35 m. p. h.

(3) It is recommended that for freight train resistances between 7 and 35 m. p. h. the formula,

$$R = 2.2\,T + 121.6\,C,$$

be used for comparing freight train ratings on different lines and grades.

R = total resistance on level tangent.

T = total weight cars and contents in tons.

C = total number of cars.

(4) In order to equalize resistance on curve and tan-

TABLE No. 7.

LOCOMOTIVE RESISTANCES

(A) CYLINDER TO RIM OF DRIVERS:
TOTAL POUNDS $R = 18.7\,T + 80\,N$
T = TONS WEIGHT ON DRIVERS
N = NUMBER DRIVING AXLES

(B) ENGINE AND TENDER TRUCKS:
TOTAL POUNDS $R = 2.6\,T + 20\,N$
T = TONS WEIGHT ON ENGINE AND TENDER TRUCKS.
N = NUMBER OF TRUCK AXLES

(C) HEAD END OR "AIR" RESISTANCE
$R = .002\,V^2A$;---- V = VELOCITY IN MILES PER HOUR
A = AREA (AVERAGE FOR LOCOMOTIVES, -125 SQ. FT.)

TOTAL $R = 0.25\,V^2$

AIR RESISTANCE (C) FOR VARIOUS VELOCITIES.

VELOCITY	R	VELOCITY	R	VELOCITY	R	VELOCITY	R
1	0.25	11	30	21	110	31	240
2	1.00	12	36	22	121	32	256
3	2.25	13	42	23	132	33	272
4	4.00	14	49	24	144	34	289
5	6.25	15	56	25	156	35	306
6	9.00	16	64	26	169	36	324
7	12.25	17	72	27	182	37	342
8	16.00	18	81	28	196	38	361
9	20.25	19	90	29	210	39	380
10	25.00	20	100	30	225	40	400

DRAW BAR PULL ON LEVEL TANG'T EQUALS THE CYLINDER TRACTIVE POWER LESS THE SUM OF ENGINE RESISTANCES.

AT LOW SPEEDS THE ADHESION OF DRIVERS SHOULD BE CONSIDERED AND AVAILABLE DRAW BAR PULL SHOULD NEVER BE ESTIMATED GREATER THAN
30% OF WEIGHT ON DRIVERS AT STARTING WITH USE OF SAND.
25% " " " " " RUNNING SPEEDS.

gent, curves shall be compensated .035 per cent. per degree of curvature. Effect of curve resistance is dispelled more slowly at slow speed than at high speed.

(5) Superelevation and depression should be equally divided between high and low rail of curve, in order to avoid shock in entering curve and exceeding maximum gradient on runoffs of curves.

(6) Condition of roadway maintenance has a great effect on train resistance.

(7) Condition of equipment has a great effect on train resistance.

(8) Train resistance is greater in cold weather than in warm. Per cent. of rating on account of variation in temperature, as shown in body of report, is recommended for use.

(9) Resistance of individual cars of same weight but of different type shows considerable variation. Sufficient data are not yet available to determine just how much the difference is.

(10) Starting resistance varies from 10 to 40 lbs. per ton. depending on loading, temperature and character of maintenance of roadway and equipment.

Curvature.

As far as known to the committee, the rail wear and other expenses of maintenance on curves are approximately proportional to the number of degrees of central angle, but there are a number of reasons why light curves are better than sharp curves. Sharp curves require greater elevation, which is objectionable and takes considerable care and close inspection to maintain correct and uniform. The track can only be elevated for one velocity, while speed of trains will necessarily vary. Straight lines and light curves permit higher safe speeds. As a general rule, it is desirable on any railway to have alinement such that trains can run as fast as possible with the greatest possible factor of safety against derailment. Curves should be made as light as practicable down to a curve where any advantage gained by making it lighter would be offset by the difficulty of maintaining the alinement.

If on any curve a train runs at a speed greater (or less) than that for which track is elevated according to formula $E = .00066DV^2$ (page 61 of Manual), the amount of unbalanced centrifugal force and the difference in weights on the two rails will be represented by the approximate formulas:

Unbalanced centrifugal force, $f^1 - f = .0177 (a^2 - 1) WE$,

Difference in weight on rails $w^1 - w = .00753 (a^2 - 1) WEH$,

Where W = total weight on both rails, H = height of its center of gravity above the rails, E = the elevation of outer rail in inches, and a = the quotient obtained by dividing the actual speed by that for which track is elevated.

These unbalanced forces vary directly as the elevation; and therefore as the degree of curve where track is elevated for a given speed.

For example, if track is elevated for 50 m. p. h. and trains run at different speeds, we would have for an engine of 100 tons with center of gravity 6 ft. above the rails.

Actual speed 60 m. p. h.,

$f^1 - f =$ 1.3 tons for a 1-deg. curve.
5.2 tons for a 4-deg. curve.
$w^1 - w =$ 3.3 tons for a 1-deg. curve.
13.1 tons for a 4-deg. curve.

Actual speed 15 m. p. h.,

$f^1 - f = -$ 2.7 tons for a 1-deg. curve.
— 10.6 tons for a 4-deg. curve.
$w^1 - w = -$ 6.8 tons for a 1-deg. curve.
— 27.1 tons for a 4-deg. curve.

Both the unbalanced centrifugal force and the difference in weights on rails are four times as much on the 4-deg. as on the 1-deg. curve. At 15 m. p. h. on the 4-deg. curve the weight on the inside rail is 63½ tons against 36½ on the outside, nearly as great a disproportion as for train standing still—which would be 65 and 35.

Where track is elevated for 50 m. p. h., as in the above examples, a speed of 83 m. p. h. on a 1-deg. curve will give the same unbalanced centrifugal force and difference in weight on rails as 60 m. p. h. on the 4-deg., and as far as these forces are concerned it is equally safe.

As a 10-deg. curve for 30 m. p. h. and a 2 deg. 30 min. for 60 m. p. h. require the same elevation, the unbalanced centrifugal force and difference in weight on rails will be the same in each case for any given percentage of increase (or decrease) in speed over that for which track is elevated.

The committee believes that the unbalanced centrifugal force is an important objection to curves and diminishes the factor of safety against derailment; and that for slow trains the excess of weight on the inside rail tends to increase the elevation of track while the pressure is lightened on the outside rails.

Curvature is more objectionable at high speeds than low. As the energy of any jolt or rebound caused by imperfect surface increases with the square of speed, the factor of safety against derailment at high speeds is diminished to that extent. Therefore any additional reduction in the factor of safety caused by the introduction of curvature is more objectionable than it would be at lower speeds where the margin of safety is greater.

It is fully realized that the subject has only been partially covered in the present report, and further data and study are needed in order to reduce to a minimum the portion of the work that must eventually rest on the judgment of the engineer.

Conclusions.

(1) A straight line is the best alinement, and with the possible exception of very light curves, it is the safest.

(2) The justifiable expenditure to eliminate one degree of central angle in the alinement of roadway depends largely on the number of daily trains and the cost per train mile.

(3) As a general rule, it is good practice to spend more money to take out one degree of central angle where the radius is small, requiring the maximum elevation of outer rail, than where the radius is large, requiring less elevation.

(4) As a general rule, it is justifiable to spend more money to take out one degree of central angle where trains run at a high rate of speed than where the speed is low.

The report is signed by: A. K. Shurtleff (C., R. I. & P.), chairman; C. Frank Allen (Mass. Inst. Tech.), vice-chairman; W. Beahan (L. S. & M. S.), R. N. Begien (B. & O.), J. F. Burns (L. & N.), A. C. Dennis (Can. Pac.), C. P. Howard (L. S. & M. S.), P. M. LaBach (Mo. Pac.), Fred Lavis (Consulting Engineer), L. B. Merriam (Consulting Engineer), C. J. Parker (N. Y. C. & H. R.), J. E. Schwitzer (Can. Pac.), F. L. Stuart (Erie), H. R. Talcott (B. & O.) and W. L. Webb (Consulting Engineer).

TRACK.*

Revision of Manual.

The committee recommends substituting the following for that portion of page 64 in the Manual, under Maintenance of Gage.

Maintenance of Gage.

(1) Tie plates should be applied in all cases where greater economy in maintenance is secured by their use than in depending on the life of the tie, limited by rail wear.

(2) Shoulder tie plates are recommended in preference to rail braces, except for guard rails and stock rails at switches, where the latter should be used.

L. S. ROSE,
Chairman of Committee on Track.

(3) For heavy traffic, shoulder tie plates should be used on all ties on curves.

(4) For medium traffic, shoulder tie plates should be used on all ties on curves over three degrees.

(5) For light traffic, the outside of rails on curves should be double spiked.

(6) The gage (tool) used should be the standard gage recommended.

(7) When track is intended to be spiked to standard gage, the rail should be held against the gage with a bar while the spike is being driven.

(8) Within proper limits, a slight variation of gage from the standard is not seriously objectionable, provided the variation is uniform and constant over long distances. Under ordinary conditions it is not necessary to regage track if the increase in gage has not amounted to more than one-half inch, providing such increase is uniform.

(9) Spikes should be started vertically and square, and

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

so driven that the face of the spike shall come in contact with the base of rail; the spike should never have to be straightened while being driven.

(10) The outside spikes of both rails should be on one side of the tie, and the inside spikes on the other. The inside and outside spikes should be spaced as far apart as the face and character of the tie will permit. The ordinary practice should be to drive the spike two and one-half (2½) in. from the outer edge of the tie. The old spike holes should be plugged.

On page 61, it is recommended that the third line from the bottom be changed to read:

"and E=elevation of outer rail in inches at the gage line."

With regard to metal portions of the track coming in contact with track circuits, the committee makes the following recommendation:

"Where there is material leakage from track circuits, track fastenings should be so designed as to prevent contact between the metal and the ballast."

The committee was unable to discuss fully the question of switchstand signals with Committee X this year, and is unable at this time to make a recommendation for a standard switchstand signal. It has, however, carefully considered the specifications for spring and rigid frogs, which were presented to the last convention as a progress report, and these specifications were submitted to the various frog and switch manufacturers in this country for their criticisms. The committee now presents for adoption the following specifications:

Specifications for Spring and Rigid Frogs.

General.

The company will furnish the manufacturer one copy of the specifications and drawings.

The drawings will show the rail sections, splice drilling, angle, alinement and general dimensions.

The drawings are intended to co-operate with and form a part of the specifications. Dimensions should not be scaled. Anything which is not shown on the drawings, but which is mentioned in the specifications, or vice versa, or anything not expressly set forth in either, but which is reasonably implied, shall be furnished the same as if specifically shown and mentioned in both. Should anything be omitted from the drawings or specifications which is necessary for a clear understanding of the work, or should any error appear either in the drawings or specifications affecting the work, it shall be the duty of the manufacturer to notify the company, and he shall not proceed with the work until instructed to do so by the company.

Materials.

Rail shall be first quality, of the section ordered, as called for by the....................company's rail specifications.

Filling between the main and wing rails, and between the main and easer rails, shall be rolled steel.

Raising blocks must be of cast steel.

Solid foot guards and beveled filler blocks not presenting a running surface may be of cast-iron.

Foot guards when made of steel shall be not less than ⅜ in. thick, of width shown on plans, shall fill the space between head and base of rail, and shall be bolted to the web of rail by bolts not less than ¾ in. in diameter. These foot guards shall be supplied at all places where protection is needed, and where conditions will not allow the above specified cast-iron foot guards.

Bolts shall be of double refined iron. Bolt iron shall have a tensile strength of not less than 48,000 pounds per square inch, and an elongation of not less than 15 per cent. in eight inches. When nicked on either side and then broken, the fracture shall be entirely fibrous and free from flaws and unwelded seams. Bolts must be round and true to size, with U. S. standard square heads and nuts. Threads must be accurately cut and nuts must have a wrench-tight fit. Each bolt must be provided with an approved head lock made of material not less than ¼ in. thick, preventing the bolt from turning, and a nut lock of approved pattern large enough to give full bearing for the nut. A ¼-in. cotter pin must be placed outside of and close up to the nut after it is tightened. Beveled washers must be used wherever necessary to give head and nut a full square bearing; they must be wide enough to act as head locks. Bolts must be long enough to allow the nuts to be brought out from under the head of the rail, with a suitable washer not less than ½ in. thick, so that the nuts may be readily tightened with an ordinary wrench.

Rivets shall be of good quality mild steel, with an ultimate tensile strength of 50,000 to 54,000 pounds.

Reinforcing bars shall be of wrought-iron or soft steel.

Plates shall be of rolled steel.

Springs shall be of best quality spring steel, and of dimensions and capacity shown on the plans. They shall meet the following tests:

(a) Each spring shall be placed on the testing machine and forced down solid four times.

(b) After the foregoing, each spring shall be placed on one end on a flat plate, and the distance between the plate and the other end of the spring measured by means of the standard depth gage; this measurement being the free length of the spring. The free length must conform to the plans within ⅛ in.

(c) Double springs shall be assembled and a load at least 25 per cent. greater than the rated capacity of the spring shall be applied for thirty seconds. Upon release neither spring must vary from its original free length. If either one does so vary, it shall be rejected.

(d) The inner and outer coils of springs shall be coiled in opposite directions.

Spring covers shall be made of malleable iron.

Braces shall be made of malleable iron.

Stops and hold-downs shall be made of soft steel.

Anti-creeping device shall be made of soft steel.

Workmanship.

The workmanship must be first class. Bends shall be made accurately and with care, so as not to injure the material. They shall be in arcs of circles and not angles.

It is desired that rails be bent cold. If heating is resorted to, it shall be done in such a manner as not to injure the rail. Welding in any part of the frog will not be permitted. Planing shall be true, and all abutting surfaces fit closely. Ends of rails shall be cut at right angles to the axis of the rail, except where otherwise shown on the plan. All burrs shall be removed.

Fillers shall fit the fishing angles and the web of the rail tight for a distance of ½ in. above and below the base and the head, respectively, and still maintain the required flangeway. Where the brand of the rail interferes with the fit of the filler, the brand shall be chipped off flush. Fillers shall be grooved or cut out to fit over rivet heads.

Heel raising blocks shall fit the head, base and web of rail equally as well as the fillers are fitted.

Beveled fillers and solid foot guards shall fit the rail sufficiently well to maintain the required spacing.

The diameters of the rivets shall be of full size shown on plan, and the diameters of the rivet holes shall not be more than 1-16 in. greater than the diameters of the corresponding rivets. The rivets shall be of sufficient length to provide full, neatly made heads when driven. They shall be driven tight, bringing all adjacent parts in contact.

Rivet heads, when not countersunk or flattened, shall be hemispherical and of uniform size for the same size rivets. They shall be full and neatly made, and concentric with the holes. When the rivet heads are countersunk they shall be flush with the plate, and fill the holes.

Reinforcing bars shall fit the fishing angles and web of rail throughout their length.

Plates shall be flat and true to surface.

Springs shall have the ends cut square with the axis, so that when the spring is placed on end on a flat surface it will stand perpendicular.

Spring covers shall be of such dimension as to permit a proper working of the springs, and shall be provided with a spring bearing for each end of the spring.

Braces shall fit the head and web of rail accurately.

Stops shall be so placed on plates as to hold the wing rail at 1⅞ in. opening at the ½-in. point. Hold-downs shall fit stops so as to allow at least 2 in. horizontal play and not more than ⅛ in. vertical play.

The anti-creeping device shall fit accurately to the parts of the frog or angle bars.

Holes shall be drilled from the solid. No punching will be permitted except in case of bottom plates and washers. Drilling shall be accurately done, on bevel where necessary, and holes shall be made 1-16 in. less in diameter than the bolt to be used. Then the parts shall be assembled and the holes reamed so they are straight and true, with no offsets between the adjacent parts, and of such size as to give the bolts a driving fit for their entire length.

In lieu of the above specification for drilling and reaming, the manufacturer may assemble and accurately fit all the parts, including the rail and fillers, before any drilling whatever is done; after the parts are securely clamped in

their correct positions, the holes may be drilled through the entire mass to the exact diameter of the bolt.

The number of the frog, maker's name, weight of rail and the date shall be plainly stamped with ¾-in. figures and letters on the flare of one wing rail for rigid frogs and the flare of both wing rails for spring frogs.

No paint, tar or other covering shall be used before inspection.

The alinement and surface of all finished work shall be even and true, and shall conform to the angles specified.

Inspection.

Material and workmanship shall be at all times subject to inspection by a duly authorized representative of the company, who shall examine the material before it is worked in the shop. He will inspect the work during progress and will also inspect the finished product, with power to reject materials and workmanship found to be unsatisfactory. He shall have free access to the shops and mills at any and all times during the progress of the work. The acceptance of any material by an inspector shall not prevent subsequent rejection if found defective after delivery or during the progress of the work, and such defective material if furnished by the manufacturer shall be replaced by him at his own expense.

All facilities, labor and tools necessary for the shop inspection shall be furnished at the expense of the manufacturer.

When the manufacturer furnishes the rails, he shall supply the company with a certificate of inspection made by some competent person acceptable to the company.

The following ten requisites for switchstands are recommended:

Requisites for Switchstands.

(1) There should be no lost motion in parts.

(2) Stands should have an adjustable throw on the foot.

(3) The operating lever of ground stands should work parallel with the track.

(4) Throwing apparatus should be so arranged that when the switch is set for movement of a train, it will be thrown to an extreme position and the throwing rod be locked independent of the latch on the stand lever.

(5) Ground stands should be provided with latches which work with the foot.

(6) The stand should be snowproof.

(7) The connection between the throwing rod and the stand should be so arranged that it will be impossible to separate the throwing rod from the stand when the stand is set up in working position.

(8) The stand should be so arranged that it can be easily inspected.

(9) The target should not show clear signal for main track movements unless the points are up snug against the stock rail.

(10) The targets shall conform to drawing No. —.

In considering the subject of lengths of switch points, it is noted that the association has adopted 33 ft. as the standard length of rail. For general use the committee recommends switch points 11 ft., 16½ ft., 22 ft. and 33 ft., with the further recommendation that the last three named lengths will most nearly meet ordinary requirements. It further recommends that the following combinations of switches and frogs be used:

11-ft. switch points with No. 6 frogs and under.

16½-ft. switch points with frogs over No. 6, up to and including No. 10.

22-ft. switch points with frogs over No. 10, up to and including No. 14.

33-ft. switch points with frogs over No. 14.

Three frogs are recommended to meet all general requirements. These are No. 8, No. 11 and No. 16. The lengths from point to toe and from point to heel, total lengths, and recommended practical leads for these frogs, with the corresponding recommended switch, are given in the accompanying tables.

The committee has further investigated the widening of gage on curves, and has received and tabulated answers to its circular from 45 different railways. It recommends for adoption the following rule:

Curves eight degrees and under should be standard gage. Gage should be widened one-eighth inch for each two degrees or fraction thereof over eight degrees, to a maximum of 4 ft. 9¼ in. for tracks of standard gage. Gage, including widening due to wear, should never exceed 4 ft. 9½ in.

The installation of frogs upon the inside of curves is to be avoided wherever practicable, but where same is unavoidable, the above rule should be modified in order to make the gage of the track at the frog standard.

The committee's attention has been called to the method of measuring frogs, and, under special instructions from the Board of Direction to recommend a definition for frog number, recommends the following:

Considering that the frog angle is the angle between the gage lines of the point rails, that the axis of a frog is the line which bisects that angle, and that the spread of a frog is measured at right angles to the axis, the number of the frog is the number of units measured on the axis in which the frog spreads one unit, from which the frog number is one-half the co-tangent of one-half the frog angle.

PROPERTIES OF FROGS. Thickness of All Frog Points 0½"												Properties of Switches. For All Switches Thickness of Point=0¼" and Heel Distance =H=6¼"					THEORETICAL LEADS						
N=Frog Number.	F=Frog Angle.			W=Length Point to Toe.		K=Length Point to Heel.		Total Length.		Spread at Toe.	Spread at Heel.	S=Length of Switch Rail.		a=Switch Angle.			R=Radius of Center Line.	D=Degree of Lead Curve.			Distance Point of Switch Rail to Theoretical Point of Frog.	Closure Straight Rail.	Closure Curved Rail.
I	II			III		IV		V		VI	VII	VIII		IX			X	XI			XII	XIII	XIV
	Deg.	Min.	Sec.	Ft.	In.	Ft.	In.	Ft.	In.	Feet	Feet	Ft.	In.	Deg.	Min.	Sec.	Feet	Deg.	Min.	Sec.	Feet	Feet	Feet
4	14	15	00	3	2	5	4	8	6	0.79	1.32	11	0	2	36	19	112.26	52	53	56	37.05	22.88	23.29
5	11	25	16	3	7	6	5	10	0	0.71	1.28	11	0	2	36	19	183.22	31	40	24	42.77	28.19	28.55
6	9	31	38	4	0	7	0	11	0	0.66	1.16	11	0	2	36	19	273.95	21	01	58	48.11	33.11	33.38
7	8	10	16	4	5	8	1	12	6	0.63	1.15	16	6	1	44	11	364.88	15	47	19	61.94	41.02	41.24
8	7	09	10	4	9	8	9	13	6	0.59	1.09	16	6	1	44	11	488.71	11	44	40	67.47	46.22	46.42
9	6	21	35	6	0	10	0	16	0	0.67	1.11	16	6	1	44	11	616.27	9	18	27	72.24	49.74	49.92
9½	6	01	32	6	0	10	0	16	0	0.63	1.05	16	6	1	44	11	699.97	8	11	33	74.90	52.40	52.58
10	5	43	29	6	0	10	6	16	6	0.60	1.05	16	6	1	44	11	790.25	7	15	18	77.51	55.01	55.17
11	5	12	18	6	0	11	6	17	6	0.54	1.05	22	0	1	18	8	940.21	6	05	48	92.06	64.06	64.20
12	4	46	19	6	5	12	1	18	6	0.53	1.01	22	0	1	18	8	1136.34	5	02	38	97.25	68.83	68.96
15	3	49	06	7	8	14	10	22	6	0.51	0.99	33	0	0	52	5	1744.38	3	17	01	133.02	92.36	92.46
16	3	34	47	8	0	16	0	24	0	0.50	1.00	33	0	0	52	5	2005.98	2	51	24	135.95	94.95	95.05
18	3	10	56	8	10	17	8	26	6	0.49	0.98	33	0	0	52	5	2587.66	2	12	52	146.38	104.54	104.61
20	2	51	51	9	8	19	4	29	0	0.48	0.97	33	0	0	52	5	3262.98	1	45	22	156.35	113.68	113.76
24	2	23	13	11	4	23	2	34	6	0.47	0.97	33	0	0	52	5	4922.77	1	09	42	175.09	130.66	130.77

Conclusions.

The committee recommends:

(1) That the recommendations contained in the report for substitution in the Manual be approved.

(2) That the resolution regarding design of track fastenings with reference to track circuits be approved as good practice.

(3) That the specifications for spring and rigid frogs and the requisites for switchstands be approved.

(4) That four lengths of switch points be approved, and the four kinds of frogs and the combinations of frogs and switches, together with the practical leads submitted, be approved as good practice.

(5) That the rule for widening of gage on curves be approved.

(6) That the definition of the number of a frog, viz., that the number of the frog is one-half the co-tangent of one-half the frog angle, be approved.

The report is signed by L. S. Rose (C., C., C. & St. L.), chairman; C. E. Knickerbocker (N. Y., O. & W.), vice-chairman; E. C. Blundell (C., St. P., M. & O.), Garrett Davis (C., R. I. & P.), R. C. Falconer (Erie), T. H. Hickey (Mich. Cent.), R. H. Howard (C. & E. I.), C. B. Hoyt (N. Y., C. & St. L.), J. B. Jenkins (B. & O.), John R. Leighty (Mo. Pac.), J. C. Nelson (S. A. L.), P. C. Newbegin (Bang. & Aroos.), R. M. Pearce (P. & L. E.), H. T. Porter (B. & L. E.), G. J. Ray (D., L. & W.), William G. Raymond (Univ. of Iowa), F. A. Smith (civil engineer), R. A. Van Houten (Lehigh Valley), W. D. Wheeler (consulting engineer), and A. A. Wirth (Penna. Lines).

PRACTICAL LEADS

N=Frog Number.	R_1=Radius of Center Line.	D_1=Degree of Lead Curve.			Rectangular Co-ordinates to the Quarter and Center Points on Gage Side of Curved Rail, Referred to Point of Switch Rail as Origin.						T'=Tangent Adjacent to Switch Rail.	T_1=Tangent Adjacent to Toe of Frog.	L'=Distance Actual Point of Switch Rail to Theoretical Point of Frog.	Lead=Distance Actual Point of Switch Rail to Actual Point of Frog.	Closure for Straight Rail.	Closure for Curved Rail.
					X	X_1	X_2	Y	Y_1	Y_2						
1	XV	XVI			XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII	XXVIII
	Feet	Deg.	Min.	Sec.	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet		
4	110.69	53	42	24	17.74	23.44	29.75	0.97	1.67	2.79	1.03	0.00	37.77	37.94	1-23.60	1-24
5	174.34	33	19	57	17.78	24.54	31.27	0.95	1.61	2.62	0.00	0.82	42.26	42.47	1-27.68	1-28
6	265.39	21	43	04	19.07	27.13	35.15	1.01	1.74	2.72	0.00	0.66	47.73	47.98	1-32.73	1-33
7	362.08	15	52	29	26.72	36.93	47.11	0.97	1.71	2.74	0.00	0.19	61.81	62.10	1-13.89 1-27	1-14.11 1-27
8	487.48	11	46	27	28.37	39.91	51.45	1.02	1.78	2.91	0.30	0.00	67.65	67.98	1-16.40 1-30	1-16.60 1-30
9	605.18	9	28	42	28.75	40.98	53.19	1.02	1.76	2.75	0.00	0.57	71.91	72.28	1-16.41 1-33	1-16.59 1-33
9½	695.45	8	14	45	30.31	43.35	56.37	1.06	1.82	2.83	0.76	0.00	75.32	75.71	1-25.82 1-27	1-26 1-27
10	790.25	7	15	18	30.28	44.05	57.81	1.06	1.84	2.85	0.00	0.00	77.51	77.93	1-27 1-28	1-27.17 1-28
11	922.65	6	12	47	40.74	56.47	72.19	1.08	1.84	2.87	2.99	0.00	93.85	94.31	1-32.85 1-33	2-33
13	1098.73	5	12	59	43.99	60.65	77.28	1.15	1.90	2.91	5.33	0.00	100.30	100.80	1-23.88 2-24	3-24
15	1744.38	3	17	01	55.49	77.95	100.41	1.01	1.78	2.85	0.00	0.00	132.66	133.28	2-33 1-25.9	2-33 1-26
16	1993.24	2	52	59	58.16	81.76	105.35	1.04	1.82	2.87	1.56	0.00	136.90	137.57	1-29.90 2-33	1-30 2-33
18	2546.31	2	14	31	58.73	84.46	110.10	1.04	1.82	2.86	0.00	1.08	145.76	146.51	1-25.93 3-26	4-26
20	3257.26	1	45	32	61.84	90.21	118.59	1.08	1.88	2.93	0.44	0.00	156.59	157.42	1-26.92 2-27 1-33	3-27 1-33
24	4886.16	1	10	21	67.82	100.21	132.59	1.27	1.97	3.00	2.43	0.00	176.22	177.22	1-32.89 3-33	4-33

TIES.*

The board of direction assigned the following subjects:

1. Consider revision of Manual; if no changes are recommended, make statement accordingly.
2. Continue compilation of statistics on life of treated and untreated ties. Digest the statistics and present conclusions derived therefrom.
3. Continue investigation of the general question of the present and future status of the tie supply; the various methods heretofore adopted for reducing the yearly demands on the timber supply, and what general lines of investigation and change in existing methods may seem most desirable to be followed so as to secure the best results in the future.
4. Continue investigation as to the extent of use, life and design of metal, composite and concrete ties. with illustrations and descriptions of the most successful designs, and draw such conclusions as the information may warrant.

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

The following sub-committees were appointed:

Sub-Committee A—Revision of Manual: E. D. Jackson (chairman), A. F. Stewart, E. B. Cushing.

Sub-Committee B—Statistics: L. A. Downs (chairman), F. G. Jonah, Hermann Von Schrenk, A. F. Dorley.

Sub-Committee C—Timber Supply and Conservation: W. F. H. Finke (chairman), G. H. Webb, Hermann Von Schrenk, A. W. Thompson.

Sub-Committee D—Metal and Concrete Ties: E. E. Hart (chairman), H. S. Wilgus, H. C. Landon.

Sub-Committee on Cypress Ties: W. F. H. Finke (chairman), L. A. Downs, A. F. Dorley, Hermann Von Schrenk.

The results of investigations are given in Appendices A, B, C, D and E, the last of these being a report on some test ties in Texas.

Conclusions.

(1) The committee recommends the approval of the changes proposed in the Manual.

(2) The committee has recommended, and the association has adopted, a series of rules and blank forms for establishing a record of ties, and the committee regrets that the blank forms have not been generally adopted by railways. After further careful study of the subject, the committee cannot recommend any change in the rules or blank forms, but again recommends their general adoption and use by railways.

It having been found impossible to obtain replies to the numerous questions embraced in the forms adopted, the practice of issuing them will be discontinued, and an endeavor will be made to obtain in other ways information which will be of value to the association.

(3) The committee concludes that the cultivation of trees as a basis of future tie supply should be undertaken where practicable.

The report is signed by: E. B. Cushing (Sunset Central Lines), chairman; E. E. Hart (N. Y., C. & St. L.), vice-chairman; A. F. Dorley (Mo. Pac.), L. A. Downs (Ill. Cent.), W. F. H. Finke (Southern), E. D. Jackson (B. & O.), F. G. Jonah (St. L. & S. F.), H. C. Landon (Erie). A. F. Stewart (MacKenzie-Mann Co.), Dr. Hermann Von Schrenk (R. I.-Frisco), A. W. Thompson (B. & O.), G. H. Webb (Mich. Cent.) and H. S. Wilgus (P., S. & N.).

Appendix A.

Revision of Manual.

The committee submits the following changes it recommends:

Definitions.

Tie.—The tranverse member of a railway track supporting the rails, by means of which they are retained in position.

Pole Tie.—A tie made from a tree of such size that not

more than one tie can be made from a section; a pole tie generally shows sapwood on two sides.

Sap Tie.—A tie which shows more than the prescribed amount of sapwood in cross-section.

Score Mark.—A mark made by the ax as a guide in hewing.

Specifications for Ties.

Under this heading the committee has made a few minor changes, consisting mostly in substitution of words, without change in substance.

Specifications for Dating Nail.

Make the first and second paragraphs read as follows:

1. The nail shall be made of iron or steel, galvanized with a coating of zinc, evenly and uniformly applied, so that it will adhere firmly to the surface of the steel; it shall be ¼ in. in diameter, 2½ in. in length, with head ⅝ in. in diameter, having stamped therein two figures, designating the year, the figures to be ⅜ in. in length and depressed into the head 1-16 in.

2. Any specimen shall be capable of withstanding the following test: The sample shall be immersed in a standard solution of copper sulphate for one minute and then removed immediately and thoroughly washed in water and wiped dry; this process shall be repeated four times, if necessary, and if after any immersion there is a copper-colored deposit on the sample, or the zinc has been removed, the lot from which the sample was taken shall be rejected.

Forms and Rules for Tie Records.

Withdraw the first paragraph and make the third paragraph read as follows:

A dating nail should be driven in the upper side of every treated tie 10 in. inside of the rail, and on the line side of the track. The tie should be laid with the end having the year stamped on it on the line side of the

TREE PLANTING.

Railroad.	Locations.	Date.	Number.	Kind.	First Cost per M.	Cost Planting per M.	Per M. Annual Maintenance	Synopsis of Replies from Railroads.
Chicago, Burlington & Quincy........	Ottumwa, Iowa.	1906	100,000	Catalpa.	$10 00	$20 00	No Figures Available.	No definite knowledge obtained from results to date, but conditions are favorable for obtaining, within about 20 years, ties and posts amounting to double the expenditure and interest on property up to present time. Expect to plant 10,000 trees in 1910.
Pennsylvania......	40 plantations between New Brunswick, N. J., and Altoona, Pa.	Some each year 1902 to 1909. Total....	2,000,000 1,200,000 230,000 3,430,000	Black Locust. Red Oak. Mix'd Species.	$5.00 to $10 from Commercial Nursery. $3 to $5 now from Company Nursery.	About $5.00 at present	Practically no charges for maintenance	Too early to now estimate returns, but are certain forest planting is best way to utilize outlying idle lands belonging to the company.
L. & N. R. R.......	Eleven locations.	Total....	868,930 570,000 630,800 14,650 2,084,380	Catalpa. Walnuts Locust. Poplar.	$5 64	$23.44, includes maintenance chgs. to date.		Unable to estimate ultimate value of the plantations for future cross-tie supply.
D. L. & W.........	Towaco, N. J., and Alden, New York.	1906 1907 Total....	44,000 50,000 94,000	Yel. Locust. Yel. Locust.	$23.02	$12.22	$1.20	Lost about 3,000 trees which were planted on low ground and did not stand the winter weather. Balance are thrifty and look well. Can't now estimate ultimate value.
Galveston, Harrisburg & San Antonio R. R.......	At section houses between New Orleans and El Paso, Texas.	1903	15,000	Catalpa.	$16.70	$12.00	$50.00	From results thus far obtained no reliable estimate of ultimate value can be made. Present results do not warrant additional planting. Catalpa is decided failure in arid and semi-arid districts of Texas. In the humid districts of Louisiana and Texas conditions do not seem favorable to its growth.
Southern Railway....	Wolf Trap, Va.	1906	40,000	Catalpa.	$19.40	$ 7.77	$ 2.84	Too early for any estimate as to ultimate value. Trees have secured fair root growth and it is expected to cut all crooked and branched trees to ground line this winter. About 5,000 seedlings failed to take root at time of planting.
Michigan Central....	Small plantations at Section Houses.	1900 1903	80,000	Catalpa.	No.	Figures.	Given.	Total of 123 acres planted. Latitude of extreme coldness was unsuitable for catalpa, and practically none of the trees grew.
Norfolk & Western.	Ivor, Va.	1905	2,000	Catalpa.	No.	Figures.	Given.	Soil and climate found unsuitable and experiment discontinued. Company has large holdings of mountain timber, also tracts in Eastern Virginia, containing both soft and hard woods, original and second growths, which are being held, only mature timbers being cut.
Penna. (N. W. Sys.)	Kosciusko, Ind.	1906	35,000	Catalpa.	$12.65	$10.46	$10.85	Can give no estimate of ultimate value.
S. A. & A. P. Ry.	Skidmore, Tex.	1909	22,000	Catalpa.	$11.60	$27.10	$32.72	No remarks.
St. L. & S. F.......	Farlington, Kan.	1880	No Figur	es Given.	....	....	....	640 acres planted, but only about 250 acres bore trees; balance were on poor, thin soil. Trees would never make ties because of poor soil, so were used for posts and poles.

Southern Pacific: Expects to soon start planting Sugar and Red Gum.
Union Pacific: Contemplates planting Catalpa on low lands owned by Company.
Delaware & Hudson Co.: Owns large tracts in Adirondacks and are now making experiments to determine what trees are best suited to soils and climate.
Northern Pacific: Have reserved from sale several million acres of their timber lands; products from these tracts to be used for future tie supply.
C. C. C. & St. L.: Near Indianapolis; started small plantation some years ago; land used was not favorable and trees were not of proper species. Never obtained any results.

track. Dating nails should be driven the same day the tie is put in.

Section foremen should be especially careful to see that the marks or nails intended to identify the ties are not injured or destroyed.

It is recommended that, in addition to the use of the dating nail, each tie be stamped with the year at the treating plant, before treatment, and, preferably, be stamped on both ends.

Specifications for Tie Treatment; Specifications for the Analysis of Coal-Tar Creosote; Determination of Zinc in Treated Timbers.

Withdraw the matter under the above headings now incorporated in the Manual. The committee understands that this subject is being considered by the Committee on Wood Preservation.

NUMBERS AND SIZES OF TIES.

Railroad.	Mileage.	Size of Tie Main Line.	Number Ties per Mile.	Trees Planted.
Southern	6588	7x7 and 9x8½	2880	Yes
Penna. R. R.	5311	7x7 and 9x8½	2880	Yes
L. & N.	4161	7x7 and 9x8½	2880	Yes
B. & O.	3402	7x7 and 9x8½	2880	No
N. & W.	1920	7x7 and 9x8½	2880	Yes
P. & R.	1491	7x7 and 9x8½	2880	No
Penna. (S. W. Sys.)	1420	7x7 and 9x8½	2880	No
Lehigh Valley	1394	7x7 and 9x8½	2880	No
N. C. & St. L.	1230	7x7 and 9x8½	2880	No
D. & H. Co.	782	7x7 and 9x8½	2880	No*
A. B. & A.	621	7x7 and 9x8½	2880	No
Cent. of N. J.	591	7x7 and 9x8½	2880	No
B. R. & P.	441	7x7 and 9x8½	2880	No
C. C. & O.	211	7x7 and 9x8½	2880	No
A. C. L.	4129	7x7 and 9x8½	2816	No
Penna. (N. W. Sys.)	1345	7x7 and 9x8½	2816	Yes
D. L. & W.	957	7x7 and 9x8½	2816	Yes
Fla. East Coast	579	7x7 and 9x8½	2816	No
C. C. C. & St. L.	2186	7x7 and 9x8½	3300	Yes
Hocking Valley	338	7x7 and 9x8½	3050	No
L. S. & M. S.	1508	7x7 and 9x8½	3040	No
Erie	2383	7x7 and 9x8½	2720	No
Long Island	392	7x7 and 9x8½	2720	No
Southern Pacific	10664	7x9x8′	2880	No*
Union Pacific	3280	7x9x8′	2880	No*
S. A. L.	2964	7x9x8′	2880	No
N. Y. N. H. & H.	2004	7x9x8′	2880	No
C. of Ga.	1913	7x9x8′	2880	No
G. H. & S. A.	1335	7x9x8′	2880	Yes
Georgia	303	7x9x8′	2880	....
M. & O.	926	7x9x8′	3164	No
Norfolk & Southern	579	7x9x8′	2816	No
N. Y. C. & H. R.	3117	7x9x8′	3200	No
Great Northern	6904	7x8x8′	2880	No
S. P. L. A. & S. L.	879	7x8x8′	2880	No
Northern Pacific	5596	7x8x8′	2900	No*
D. & R. G.	2709	7x8x8′	3200	No
C. B. & Q.	8735	6x8x8′	3200	Yes
C. R. I. & P.	6781	6x8x8′	3200	No
St. L. & S. F.	4727	6x8x8′	3200	Yes
Grand Trunk	4599	6x8x8′	3200	No
M. K. & T.	2837	6x8x8′	3200	No
Col. & Sou.	1084	6x8x8′	3200	No
Maine Central	931	6x8x8′	3200	No
C. & E. I.	817	6x8x8′	3200	No
C. I. & L.	578	6x8x8′	3200	No
El P. & S.-W.	808	6x8x8′	3200	No reply
St. L. B. & M.	399	6x8x8′	3200	No
Ft. W. & D. C.	454	6x8x8′	3080	No
C. & N.-W.	7910	6x8x8′	3000	No
C. M. & P. S.	1276	6x8x8′	3000	No
C. M. & St. P.	7266	6x8x8′	3000	No
C. I. & S.	325	6x8x8′	3000	No
St. L. S. W.	1327	6x8x8′	2992	No
M. & St. L.	998	6x8x8′	2992	No
S. A. & A. P.	723	6x8x8′	2992	Yes
Rutland	415	6x8x8′	2992	No
Mo. & N. Ark.	313	6x8x8′	2992	No
S. Fe P. & P.	364	6x8x8′	2900	No
L. E. & W.	872	6x8x8′	2880	No
G. R. & I.	583	6x8x8′	2880	No
W. & L. E.	442	6x8x8′	2880	No
N. W. Pac.	404	6x8x8′	2880	No
Mo. Pac.	6298	6x8x8′	2816	No
B. & M.	2303	6x8x8′	2816	No
K. C. M. & O.	637	6x8x8′	2816	No
Tenn. Cent.	291	6x8x8′	2816	No
C. G. W.	1380	6x8x8′	2880	No
C. H. & D.	974	6x8x8′	3168	No
M. C.	1732	6x8x8′	3564	Yes
Bangor & Aroostook	515	6x6x8′	2880	No
N. Y. O. & W.	493	6x9x8′	3120	No
M. J. & K. C.	401	7x9x9′	3168	No
C. St. P. M. & O.	1673	7x7x8′	2816	No
D. S. S. & A.	588	7x7x8′	2730	No

*Indicates that while no trees have been planted, the question is now under consideration.

Appendix B.

Statistics.

The committee issued a circular to about 700 railways, asking the following questions:

(1) Have you now in use on your road forms similar to M. W. 300, 301, 302, 303 and 304?

(2) Do you expect to put them into use?

(3) In your judgment, would the results justify each railroad to make an actual count of the number of each kind of ties in the track as a basis for future report?

In answer, 45 replies were received, but from this number the committee received little encouragement.

To the first question, as to whether the blank forms recommended had been put into use, but four answers were in the affirmative. In a few instances railways use a form similar to the section foreman's blank.

To the second question, as to whether the respective railways would put the forms into use, five roads replied in the affirmative; the remainder in the negative.

To the third question, relative to making an actual count of the number of each kind of ties in track, 18 roads replied in the affirmative, and 19 in the negative.

In addition to answering the questions propounded by the committee, some of the replies contain comments which are published in the report. These comments include the following:

The committee would meet with greater success if it asked for less, and included only such questions as could be answered without too much labor; there are a total of 174 questions on the four forms for each division.

Better results would be secured if statistics were kept on a few representative sections only.

Dating nails disappear after a few years.

Section foremen's reports contain many errors; too much guess work is required, and the foreman does not keep the same position long enough.

It is suggested that instead of dating nails, a certain number of test ties be put in, those of each kind and date being put at a certain mile post.

It is the opinion of the committee that if the blank forms (M. W. 300, 301, 302, 303 and 304) were put in use by railways and the information accurately given, valuable statistics of ties would be obtained, and this information would be of much benefit to the management of roads in determining their course in the matter of cross-ties for future use.

The committee believes that its future work should be confined to such roads or officers as may be interested in the matter.

Appendix C.

Timber and Conservation.

The sub-committee was directed to:

(1) Compile information as to results to this time of tree planting by various railways.

(2) To ascertain the number of ties used per mile and percentage of rail length having bearing on ties.

(3) Advise the Special Committee on Conservation of work undertaken that might bear on the work of that committee, and furnish it any data or assistance it should desire; also prepare a map showing the present forests of the United States.

Compilations of the data received are attached as Exhibit 1, covering subject (1); Exhibit 2, covering subject (2); Exhibit 3, being map showing forest regions of the United States, with estimate of the area and stand; this map is a copy of map accompanying Forest Service Circular 166 of July 10, 1909, on Timber Supply of the United States. [Railroad Age Gazette, Sept. 10, 1909, p. 447.]

The following conclusions may be drawn:

(1) No cross-ties have yet been produced from trees planted by any railway.

(2) Of the total number of trees planted, the locusts predominate, with catalpa second; results to date favoring the former, though it is perhaps too early to fairly estimate the ultimate value of any of the plantations now under cultivation.

(3) With the exception of the years 1907 and 1908, there has been, since 1900, a steady increase in the number of trees planted, indicating that more attention is being given the question of providing a future cross-tie supply.

(4) The railway which has planted the greatest number of trees has decided that tree planting is the best way to utilize its idle outlying lands.

(5) While such a large percentage of roads reporting plantations also report failures, or at least unsatisfactory present results, the information received indicates that the failures, to a large extent, are due to unfair experiments, and where plantations are contemplated it is recommended—

First—That the species of trees to be grown be selected only after careful and expert study of the available soils and climate; and

Second—That where plantations are made, they be of such extent as to warrant a maintenance appropriation sufficient to insure proper attention.

(6) Tree culture should be encouraged where practicable; that the number and variety of experiments be increased each year to the end that the trees most suitable

for the various climates, soils, etc., may soon be known and their production specialized; this is important, because, with the timber supply rapidly diminishing, it is unwise to plant any one species and then defer other planting for five or ten years awaiting results of the first planting, which may be a failure.

(7) Where railways have outlying lands on which second growth timber is appearing, or where a natural original forest is growing, those tracts should be carefully preserved and the native timbers added to, if practicable; especially if those tracts contain trees of the semi-hard varieties, which can be effectively treated, and are of comparatively rapid growth.

Appendix D.

Metal and Composite Ties.

This report is a continuation of last year's, and consists of reports on experience with various ties, as follows:

Carnegie I-Beam—B., R. & P.; B. & L. E.; N. Y. C. & H. R.; P. & L. E.; Union R. R.; Penna. Lines; P., S. & N.; C., C., C. & St. L.; B. & M.; Dul. & Iron Range; Nor. Pac.; Lake Terminal; Lehigh Valley; D. & H.; Lake Champlain & Moriah; also a number of interurban lines.

Through Type Ties.—Mexican Ry.; B. & L. E.

Metal Tie Co.—B. & O.

Snyder—Penna. R. R.

Combined Wood and Steel.—L. S. & M. S.

Concrete—L. S. & M. S.; Penna. Lines; Chic. & Alton; G. H. & S. A. These ties are: Buhrer, Riegler, Kimball, Atwood and Percival.

Proceedings

The Wednesday morning session of the Railway & Engineering & Maintenance of Way Association was called to order by President McNab, 9:30 o'clock.

Discussion on Economics of Railway Location.

A. K. Shurtleff (C. R. I. & P.): D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines West, in a paper before the Western Railway Club, in December, 1901, gave a diagram of drawbar pull which coincides closely with some of the diagrams in Appendix A. The drawbar pull dropped rapidly from a velocity of about five miles per hour. The Master Mechanics' curve show a very uniform drawbar pull up to about ten miles per hour. As a matter of fact, we are not able to get it in practice. The cut-off is such, in burning our Western coal, particularly, as to start in at from five to seven miles per hour with the freight locomotives, otherwise we could not maintain steam in our boilers. Another thing Mr. Crawford called attention to was that, after a number of dynometer tests, no material increase in resistance within the ordinary range of freight train speeds was noticable. This is in contradiction to Mr. Wellington's and other formulas. In other tests, since made, that has been shown to be true.

We believe our methods of determining the drawbar pull is logical; we know that it takes certain heat units to make steam, and, therefore, the quality and quantity of fuel required determines the steam producing capacity of the locomotive, with its heating surface being known. George R. Henderson's work goes into this quite thoroughly, and it does seem consistent to do away with any arbitrary mean effective pressure curve in trying to determine the power of a locomotive for the purpose of this association. It would also be true as far as determining the power of a locomotive for tonnage rating.

L. C. Fritch (C. G. W.); There are a great many formulas to establish the hauling capacity of locomotives, yet I think out of all of them we can select some rational formula that will pretty nearly cover the conditions under which we are operating to-day. Recently the American Locomotive Co. issued a pamphlet on train resistances, which shows the remarkable difference in the resistances in lightly loaded and heavily loaded cars. For example, as I recall it now, a 50-ton capacity car empty, or lightly loaded, has a resistance per ton of about 8.5 lbs. If that car is loaded to its capacity it has a resistance of about 2.6 lbs. per ton. In tonnage rating these conditions are not always taken into account. I do not believe we have taken into consideration the internal resistance of the engine, i. e., the loss between the cylinder horsepower at the brim of the wheel. The committee uses, in Table 7, 18.7 lbs. per ton of weight on drivers. From the tests published by the American Locomotive Co. that is a little bit low. They give 22.2 lbs. I would like to ask the committee if it has taken into consideration these tests of the American Locomotive Co.

Mr. Shurtleff: No. However, we have considered the St. Louis tests, and there certainly is a difference in resistance with reference to the weight on drivers, depending on the number of drivers which are carrying the load, the same as it is in the case of freight cars as to the number of wheels that carry the load.

Mr. Fritch: I believe many roads in the past have spent a lot of money unnecessarily in the reduction of grades. I think that in many cases it is possible to use heavy engines, where traffic is comparatively light, instead of spending a lot of money on grade reduction.

The usual method now in establishing the economy of a grade reduction and line improvement, has been to determine how many train miles could be saved, and applying some value to this saving, capitalizing that amount to determine the amount you are justified in speending on grade reduction. This is only a very rough approximation. There is another system that has been used, and that is to fix the capacity of the line in ton miles per hour, taking as an ideal condition a straight and level road taking a certain class of power and determining the quantity of traffic that that particular locomotive can handle over that line in ton miles per hour and calling that percentage 100. Then assume new grades, etc., and determine the capacity of the line on that basis. In that way you get a direct measure of the efficiency of the line. I believe that is the more accurate method than to estimate the saving in train miles. By this ton miles per hour method you give a value to each particular part of the line, and take account of every element that enters into the problem. I suggest that the committee take up that line of investigation.

The secretary read conclusion 1.

Mr. Fritch: What is meant by "percentage of efficiency of drawbar pull?"

Mr. Shurtleff: In existing lines it is very rare that 100 per cent. total efficiency is realized throughout the year. Therefore, in comparing a new line with an existing line, on the new line we should use per cent. efficiency, and the same rate should be used for the two routes. If you felt that possibly rules could be put into effect to increase the efficiency of the old line to 90 per cent. you would use 90 per cent. in both cases.

Conclusion 1 was adopted.

The secretary read conclusion 2.

Mr. Fritch: I would suggest that you add there the weight on the drivers also.

Mr. Shurtleff: Does not the word "adhesion" cover the point?"

Mr. Fritch: The weight on the drivers is an element of its tractive power.

Mr. Shurtleff: Adhesion is the weight on the drivers multiplied by the co-efficiency of adhesion, so that the total adhesion is a factor of the weight on the drivers.

Mr. Fritch: Adhesion may vary in different cases, but the weight on the drivers is constant.

F. S. Stevens (P. & R.): Without the weight on drivers we would have no adhesion and there would be no power. I think the conclusion as drawn is correct.

Mr. Shurtleff: The weight on the drivers is always constant, while adhesion is not constant. The tractive power would vary as the adhesion varies, and, therefore, I cannot see why we should mention speecifically the weight on the drivers. The only place adhesion enters in it is where a locomotive is over-cylindered, as you might say, and can develop at low speed power at the rim of the drivers which would slip the drivers at such a time; you must consider adhesion in estimating tractive power.

G. W. Kittredge (N. Y. C. & H. R.): I move that conclusion 2 be adopted, although Mr. Lum has suggested that a very important factor has been left out of the conclusion; that is the man at the throttle.

Conclusion 2 was adopted.

The secretary then read conclusion 3.

Mr. Shurtleff: I wish to modify conclusion 3. Since this report was complied we have found a shorter way of reaching the results obtained in Table 1. We have found that the steam produced per square foot of heating surface is more directly in proportion to the coal burned per square foot of heating surface. Therefore we have changed Table 1 to show the number of pounds of steam per pound of coal, varying with the ratio of coal burned per square foot of heating surface. It simplifies the table very much. Therefore, I desire to change conclusion 3 to read: "The steam-producing capacity of a locomotive depends mainly upon the quantity and quality of the fuel burned, and the area of heating surface." I think that covers Mr. Lum's point about the man at the throttle.

Conclusion 3, as amended, was adopted.

The secretary then read conclusion 4.

Mr. Shurtleff: We want to change this to "Knowing the area of heating surface, etc.," eliminating the reference to grate area.

Conclusion 4, as amended, was adopted.

Conclusions 5, 6, 7, 8 and 9 were adopted.

The secretary then read conclusion 10.

Prof. W. D. Pence (Univ. of Wis.): Regarding these two figures, 30 per cent. and 25 per cent, respectively, taking the place of the older figure of 20 per cent., I should like to know the basis on which they are calculated.

Mr. Shurtleff: With sand, 33 per cent. has been realized, to my certain knowledge. But we place 30 per cent. as a maximum with sand, and 25 per cent. as a maximum for good rail without sand.

Mr. Fritch: I think the committee is safe in establishing those percentages, because the head of the rail is wider than formerly and the adhesion is greater.

C. S. Churchhill (N. & W.): In taking up the question of changing grades and such matters as that, we don't want to use maximum figures, such as 25 per cent. We want to use a figure that has proven to be a safe figure. We are using 22½ per cent. ourselves.

Mr. Shurtleff: I would say 22½ per cent. is the safe figure, but the doctors have disagreed very much upon this question.

Prof. Pence: The 22½ per cent. figure has been pretty extensively used as a conservative figure. This is a conservative committee, and I am sure no one would expect them to recommend a thing that would be dangerous to depend upon in spending money on economic improvements. Would the committee be disposed to add something that would call attention to the point of danger by the use of extreme maximum?

Mr. Shurtleff: There was considerable discussion at the November meeting of the committee on this question of adhesion, and we decided that no greater adhesion than these figures should be considered. The question as to what might be used will vary with locality. In the arid West, where dew and frost on the rail is unknown, adhesion can be taken as being higher than in the South and in this section of the country. Therefore I would consider that 25 per cent. is the maximum that should be considered in any section. I would put it at a lower figure in a country similar to this, where we have heavy dews, frosts, and a great deal of humidity in the air.

W. G. Raymond (Univ. of Iowa): Doesn't the committee, in view of what the chairman has said, want to change the words "not usually" to "never"?

The President: The committee desires to eliminate the word "usually." The particular sentence then reads: "Available drawbar pull at starting, with use of sand, should not be considered as greater than," etc. With that amendment. conclusion 10 will stand.

The secretary then read the conclusions under Train and Curve Resistance up to and including 1 (h).

C. E. Lindsay (N. Y. C. & H. R.): Does the committee include superelevation under "Condition of track surface," or should that be included under "track"?

R. N. Begien (B. & O.): I think it should be added to that paragraph.

The President: Do I understand that that sub-section (d) will then read, "Condition of track surface and rail elevation"?

Mr. Fritch: Would it not be more consistent to put (d) under the "Track"?

Mr. Shurtleff: As I understand it, "Condition of track surface" will show the relative elevation of rails, mechanically or graphically shown by the apparatus, and I hardly think we would have to specifically state: "and curve elevation."

The secretary then read down to and including 1 (m).

Mr. Fritch: Would the committee object to changing (m) to "Kind and quantity of ballast"?

The President: That is acceptable to the committee.

The secretary then read down to and including conclusion 2.

W. H. Courtenay (L. & M.): Has been conclusively established by experiment?

Mr. Shurtleff: I have personally been connected with dynamometer tests where we took particular pains to find out the resistance of the train at various maintained speeds, and there was only about three or four-hundredths pounds per ton of train variation between the speeds of 10 miles per hour, 28 miles per hour and 35 miles per hour, and that variation could easily have been caused by track conditions. Mr. Crawford, in the paper I referred to before, called attention to this point. He had a hard time trying to make his dynamometer tests fit the estabished theories with reference to train resistance, and others have found the same thing to be true. I believe Mr. Wyckhorst, in his paper before the Western Railway Club, brought out the point that within the ordinary limits of freight train speeds, I think be mentioned up to 35 miles an hour, the resistance is practically the same. The velocity resistance will increase as speed increases, but journal friction will reduce as the temperature of the journals increase, until the temperature reaches about 100 degrees. This modification in journal resistance will practically offset the head-end resistance. I think that Prof. Goss has established pretty well the fact that the velocity resistance should not be applied to each ton of train; in fact the velocity resistance at the front end of the train is considerably greater than the velocity resistance at the intermediate portions or cars of the train, and the end resistance is higher than the intermediate portion.

Prof. C. F. Allen (Mass. Inst. Tech.): This same result has been shown by a committee report on train resistance, three years ago, by Mr. Shurtleff's experiments, by Mr. Dennis' experiments, by records of the B. & O. on freight trains, and by the American Locomotive Co. pamphlet that has been spoken of, based on experiments on the Pennnsylvania R. R. In the compilation made three years ago there was only one set of experiments quoted on what you might call heavy freight trains. There was one freight train of a little over 100 tons, the Daniel experiment, and the formula given by Mr. Daniel did show an increase due to velocity. I platted those experiments, and, with the exception of one record at a very low velocity, which would mean high resistance, the straight and level line on the diagram fits quite as well as the line that Mr. Daniel suggested, so that at the present time the situation is substantially this: We have five or more authorities to the effect that the resistance does not increase with velocity, and as far as heavy freight trains are concerned I know of nothing pointing in the other direction; so that I find myself quite unable to resist the conclusion, at present, that the resistance is independent of velocity. It seems to me that we must accept that, however difficult it seems.

Mr. Fritch: If so, why can't we haul maximum freight trains as well at 35 miles per hour as we can at 10? But I think it is perfectly clear. It is not due to increase in resistance. It is due to the decrease in the capacity of the locomotive. So I think that makes it quite clear, that if a locomotive could maintain its capacity up to the speed of 35 miles per hour, if the steam could be made and supplied at that rate, the freight trains could be hauled at 35 miles per hour as readily as at 10 miles per hour. That is one advantage of the electrical locomotive. The electrical locomotive does not lose its hauling capacity in proportion to its speed, and with the use of electrical locomotives you will be able to handle maximum freight trains at 30 miles per hour as well as you will at 10 miles per hour.

Prof. Pence: Taking Dean Goss' conclusions with respect to the substantial constancy of horse power of the locomotive, this matter Mr. Fritch has just mentioned must depend on the tractive effort. If the speed is equal to 375 times the horse power, divided by the tractive effort, that must be the direct result of the hauling tractive effort.

Conclusion 2 was adopted.

The secretary then read conclusion 3.

Mr. Fritch: The grade element is not taken into consideration in that formula. If you would say, "Ratings on different lines, with the same grades," it would be all right.

Prof. Allen: It says "R is the total resistance on level tangent."

Mr. Fritch: That is clear, but the formula, as it stands, should not be used for comparing ratings on different lines and grades. You would have to add the grade resistance.

Mr. Shurtleff: We would naturally suppose any man who is authorized to calculate those things would know he should make the corrections for grades and curves.

Conclusion 3 was adopted.

The secretary then read conclusion 4.

Mr. Fritch: I am reminded of the remarks Mr. Churchill made a few moments ago, that we don't want to take the maximum conditions, or the minimum conditions, rather in this case. I don't believe 0.035 is sufficient to allow for curve compensation. The tests shown in this report indicate that 0.03 is probably too low, and that at 0.04 trains gain speed around the curves. That may be true in cases of selected trains or selected conditions, but I believe that the average condition will be such that 0.04 is a more reasonable amount to use. There are many who have used 0.05, but if you take a crooked line, where a train would lap over two or three curves, the resistance would be more than even 0.04. Then again, there is no distinction made

between curves of different radii. The distance is greater on curves of short radii than on curves of long radius. So I believe that ought to be changed to 0.04.

Mr. Shurtleff: Besides the results as obtained on the Baltimore & Ohio in making tests with reference to curves and distances, I will call attention to the tabulated extracts from answers to the committee circular of October 19, 1907. There are some pretty good authorities there on that point. E. H. McHenry, of the N. Y., N. H. & H., found 0.03 per cent. compensation too low and 0.04 too heavy. H. R. Talcott, B. & O., A. V. Kellogg, Sou. Pac. (Atlantic system), found the same. In some tests, analyzed by myself, for Mr. Berry, we found with new rail that trains at less than 10 miles per hour retarded on 0.03 compensation and accelerated on the same curves at higher velocities. Mr. Merrian, of the Grand Trunk Pacific, found 0.04 too high for new rail. Mr. Kittredge, N. Y. C. & H. R., found 0.03 made limiting grades on curves, but that 0.04 was all right.

G. W. Kittredge: I wish to vote unhesitatingly for 0.04 to-day.

Mr. Shurtleff: Mr. Wendt found 0.035 all right. Mr. Stuart found the same; trains accelerated when loaded for 1 per cent. grade on curves compensated at 0.035. Mr. Courtenay, L. & N., found 0.03 too low. H. T. Douglas, Jr., W. & L. E., used 0.03, but believes 0.04 better. Mr. Churchill, N. & W., found 0.035 all right; he finds that trains accelerate on 0.04. Mr. Schwitzer, Can. Pac., found that trains accelerate on 0.04 compensation. A. C. Dennis, Can. Pac., found 0.04 all right up to five degrees, and too high for sharper curves. V. C. Bogue, West. Pac., found 0.04 used, but probably is higher than necessary. H. F. Baldwin, Wash. & Oregon, found that heavy trains stalled or retarded on 0.04 and found 0.05 all right. W. S. Dawley, Allegheny Imp. Company, found with 0.05 compensation trains loaded for 10 miles per hour on ruling grade tangents retarded on curves, while 15 miles per hour trains accelerated. So there is a considerable variation there.

Mr. Jenkins: If a line is built exclusively for freight traffic and superelevated for low speed, you will find that 0.003 is even too much. I have observed a train going over such a line, and in every instance the speed would be accelerated on curves and retarded on tangent with only 0.003 compensation, but when a line is mixed traffic, both passenger and freight, and is superelevated for the passenger traffic, the increase of pressure on the low rail increases the friction so greatly that 0.035, I think, is about right. On a purely freight line I am of the opinion that 0.025 would be sufficient.

Mr. Shurtleff: There is another point. On a worn rail the resistance would be different. It is difficult to reach the same results unless the trial is made over the same points in track, and it is pretty difficult to reach the exact amount.

Mr. Fritch: I think that is the best argument for making this a limit that could be reasonably attained under all conditions. I would rather be on the safe side than be just at the limit point.

Mr. Lindsay: On the New York Central, where we had a 5-degree curve, the rail was elevated, as I recall it, 2½ or 3 in. That was the first stalling point that our test trains encountered. Trains uniformly stalled on that curve. We reduced the elevation to one-half inch and eliminated that as the stalling point. The grade was compensated for 0.3 per cent. After that elimination we found 0.03 was insufficient and that the trains stalled at other points on the hill.

Mr. Fritch: I move that, in conclusion 4, 0.35 be changed to 0.04.

Mr. Begien: I would call attention to the fact that it is necessary, especially on long supported grades, that with very heavy curvature, to hold down the rate of compensation to the lowest possible minimum. On very long grades the loss of elevation, due to compensation of curvature, is very expensive. It may lower the summit elevation, such as to lengthen the tunnel quite a number of hundred feet, or if the tunnel is retained at its constant elevation it may heighten the fall in the sag, where the expense is considerable. I think it is a well-known fact that curve resistance on light curves is greater per degree than it is on very heavy ones. Of course, at the top of a grade, if we have a heavy curve, it is necessary to compensate it more than you would one at the bottom, where there is a chance of getting a run.

Mr. Fritch: The difference between 0.035 per cent. and 0.04 or 0.05 per cent. would make a difference of 0.26 of a foot in the grades between the two points. It seems to me so slight a difference that it would not cut much figure in the cost of construction.

A. W. Sullivan (Mo. Pac.): In seconding Mr. Fritch's motion, I would like to point out the fact that we are dealing with a vital matter, and something you are building which cannot be changed. An error in the elevation of the curve can be readily remedied, but a mistake in grades cannot be changed without a very heavy expense, and I am in favor of the limit of 0.04 rather than 0.035.

Mr. Kittridge: I would offer as an amendment to that motion that the clause be changed to read that the maximum shall be .04 per cent.

J. O. Osgood (C. of N. J.): This is a subject on which we ought to have considerable experience by this time. When the Atchison was built to the Rocky mountains, the line was compensated for hundreds of miles to the extent of 0.04 per cent. per degree, part of it 0.05, and part of it 0.06. Years later, the West Shore was constructed with compensation, as I remember, of 0.03. If anyone here is familiar with the operation of the curves on these lines, he should be able to give us some information from practical experience.

The President: The amended motion is that conclusion 4 shall read: "In order to equalize resistance on curve and tangent the maximum compensation shall be 0.04 per cent. per degree of curvature."

W. L. Webb (Con. Eng.): I think there is one point that is not considered there. I think the rate of compensation should never be made absolutely constant, because the effect of that compensation on the construction and on the ruling grade should be taken into account. There are places where an excessive compensation can be harmlessly introduced, and in those cases it is perhaps wise to put the rate of compensation up as high as 0.05, but then, as has been pointed out, there are cases where the rate of compensation has a very important influence on the cost of construction, and so we must take the best that we can for average conditions, rather than for the unfavorable conditions that might sometimes happen. Wherever there is a limitation, as there is in many cases when compensation is put in on a ruling grade, I think we must use average conditions. I think the tests that have been made all over the country show that for average conditions 0.035 is more nearly correct, although 0.04, or even 0.05, occasionally may be proper and desirable.

F. M. Patterson (C., B. & Q.): Some roads have conducted compensation tests with dynamometer cars. I have in mind a case of a 7 deg. 30 min. curve, turning through 90 degrees, at the foot of a 0.5 per cent. grade. The maximum compensation on that line was at the rate of 0.03 per cent. per degree, and it was found in actual practice to be much too low. There was a long tangent before entering the curve, so the freight trains could get a good run for it, but they would either be stalled or the speed would be reduced to such an extent that they could hardly get around. On the 0.5 per cent. grade they would pick up speed and go over the hill without any trouble. Mr. Wickhorst made some experiments on that track with the dynamometer car.

M. H. Wickhorst (Eng. of Tests): As I recall it, the results of these tests showed that the resistance of the curve would amount to about 1.5 lbs. per ton, and the proper compensation in that particular case would be 0.07 per cent., or so. I found a similar result in one other test.

The experiences we have been listening to here seem to indicate that the criterion must be this: If you are running along with a train on a grade and find, when you come to a curve, with the throttle left about the same, that the speed drops down, it is apparent that the compensation is not enough. If the speed increases, you have too much compensation. I judge from the figures Mr. Shurtleff has given that perhaps the general experience of other engineers ought to overrule the results I got in that particular case.

Mr. Fritch: The committee seems to lay a good deal of stress on the increased cost between the two compensations. I think the point Mr. Sullivan raised is very important. Suppose you have a mile of 3-degree curve, and at the summit you have a tunnel, if you give that an increased compensation of .04 instead of .035, you only get .79 of a foot increase in elevation. I would rather spend my money in doing that.

Mr. Begien: A grade a mile long is a short grade. In almost any line revision we reduce grades at present by cutting down a number of summits, and in this way grades 15 or 20 miles long result. I have personally projected 20-mile grades in the last few years, and the difference in compensation of a line that carries 69 or 70 per cent. curvature, as they do through the eastern part of the United States and the Alleghany mountains, amounts to considerable. An average of seven or eight ft., distributed over 20 miles of line, will result in a very material difference in the cost.

I do not think we ought to set a maximum compensation for curvature, for the reason if you had a curve at a station where every train stops, or at a water station, it is necessary to compensate that curve considerably more than you would a curve where the running of the train was constant. I would further call attention to the fact that this .035 compensation was based on actual data, and I suppose, in the absence of any other information, that the .04 is based more on guesswork than anything else.

Hunter McDonald (N. C. & St. L.): I think this discussion is developing the fact that if you undertake to fix a standard for this amount you will fix it so that it cannot be used in a great many instances. I think, therefore, that this matter should be given further consideration by the committee and that it should enlarge its conclusion with some description as to the conditions under which this per cent. should be varied from. I do not think that this house should undertake to alter the conclusion of the committee; if its conclusion is not satisfactory it should be asked to give it further consideration.

Mr. Shurtleff: We have, in our report, recommended these conclusions for present adoption, with a view to future study on all of these points. We do not expect to cover this field in one year, two years or five years. We thought we had pretty good authority for recommending .035 compensation. I know where .03 has been used in mountain lines, and the curves have become the controlling points. I know where .04 has been used, and the curves have become the accelerating points. I believe that this is a local question, depending on conditions and the maintenance of the grade and elevation. I do not think that we are too high in this figure, but I see no serious objection to changing this as Mr. Kittredge has suggested.

Mr. Fritch: I would like to see Mr. McDonald's suggestion carried out. If we adopt .035 now and change to a higher compensation later, we would be put to an additional expense for changing what we have done.

Mr. McDonald: I suggest that the committee in its next report bring in a conclusion as to the conditions under which this percentage should be varied from.

Mr. Osgood: It seems to me the principal objection to the .035 per cent. is that it is too fixed. The report says "curves shall be compensated .035 per cent. per degree of curvature." So far as I can see, there is general agreement that the compensation should be somewhere between .03 and .04. Would it not be better for the present to say, "Shall be ordinarily compensated," etc.

The amendment offered by Mr. Kittredge was put to vote and lost.

Mr. Shurtleff: Mr. Osgood's suggestion as to the insertion of the word "ordinarily" will be acceptable to the committee.

Conclusion 4 was adopted with the word "ordinarily" inserted before "compensated."

The secretary read conclusion 5.

G. D. Brooke (B. & O.): In the discussion of conclusion 4, no mention has been made of the exact gage on curves, and that is evidently a feature which will affect the resistance. I would suggest that in connection with dynamometer tests, in section (d), "Condition of track surface," we provide that the exact gage on all curves be accurately given.

Mr. Shurtleff: How would it do to make section (d) read: "Condition of track surface and gage"?

Mr. Brooke: That will be acceptable.

Mr. Lindsay: How far is the superelevation and depression provided in paragraph 5 observed by railways? From our point of view, it is undesirable to depress the low rail below the grade line.

Mr. Shurtleff: To my knowledge that practice exists on the Union Pacific and on the C., R. I. & P. It was put into effect on the Union Pacific for the purpose of reducing the entrance resistance to curves, the curve run-offs. By the way, as an explanation, curves two degrees and under are not spiraled; the run-off is carried off in the tangent. Unless the grade be compensated on the run-off, the entrance resistance to these curves was increased. We know that the entrance resistance to curves is pretty heavy anyway, because of the skewing of the trucks in succession, and we desire to bring that entrance resistance down to the minimum. The method of depressing the inner and raising the outer rail equally compensated the grade of the run-off.

Mr. Lindsay: I appreciate the theory, but desire to know the extent to which it is put into practice. If there are any representatives of the two roads mentioned here, I would like to hear from them as to how they maintained the curves.

Mr. Fritch: There is another point that hasn't been brought out, as indicating an advantage in the use of the method prescribed by the committee, and that is on curves on limiting grades with the elevation all on the outer rail. If you are using momentum grades and come to a curve that is elevated 7 inches you must raise the entire weight of the train 3.5 inches, which will have a great effect in retarding the momentum of that train.

E. F. Wendt (P. & L. E.): The Committee on Track has heretofore considered the superelevation of curves, and on page 62 of the Manual you will find that it is recommended that the inner rail be retained at grade.

Mr. Begien: This subject is given consideration with a view to train resistances and especially with reference to track maintenance. Personally, I do not see why it would be any harder to maintain the track with the inner rail slightly depressed than it would be to hold it at grade.

Mr. Kittredge: I move as an amendment to this conclusion that the superelevation of curves be obtained by the elevation of the outer rail. However, the convention being on record, as cited by Mr. Wendt, might make it unnecessary to mention that fact here.

Mr. Shurtleff: I think Mr. Begien has just covered the point as to why it is brought in here. It must be considered in train resistances. If you are going to make the superelevation by maintaining the inner rail at grade, you have increased your grade resistance on entering curves, particularly on supporting grades. Mr. Fritch brought up the same thing. We have increased the grade resistances, and if there is anything to be changed the chairman of this committee desires that the Track Committee change its conclusion which has been adopted in the past.

J. B. Jenkins (B. & O.): I think the best way to arrive at the proper result, as to train resistances, would be to drop the grade line so as to keep the center of gravity of the train at proper elevation. If you establish your grade line with just the compensation on curves, and then drop your low rail, you will not have sufficient ballast under the low rail. It is better to fix the grade line and keep the low rail as grade line for the top of rail. There is another thing. The superelevation of track is frequently changed with the change in schedule speed. If the grade line is a mean between the two rails, then when you change the superelevation there will be a different relation between the sub-grade line and the top of the low rail because of such change, and it will have considerable effect on your structures, bridges, etc. You will either have to raise the grade line on tangents when you increase the superelevation, or else you will have to drop the bridge floor.

W. M. Camp (Ry. & Eng. Review): This question was pretty thoroughly threshed out when it came before the Track Committee. There is a difficulty in maintaining elevation when you depress the lower rail. It works all right when you have the engineer's stakes to go by when the track is first put up, but in subsequent maintenance it does not. If you get a low place in the vicinity of your depression, the foreman has nothing to go by in sighting his rail, whereas if the low rail is carried to grade all around, he has the tangent on either side to guide him in keeping the rail in surface, and of course he uses his level board in keeping up the upper rail. I have seen that question come up a good many times in practical work, and considering that section men do not have grade stakes to go by at all times I think it is better to keep the lower rail at grade and elevate the outer rail.

Mr. Lindsay: I would like to know if there are any gentlemen who maintain the track by depressing the lower rail half of the elevation and raising the outer rail the other half.

D. W. Lum (Sou.): I would like to ask these gentlemen how they get the lower rail down? I do not believe it is possible. I believe if you run over the road after a few months you will find your section masters, in spite of your orders, surfacing the low rail by the superelevation after they surface the high one. If the reverse, however, is true, I cannot imagine how they accomplish it. I have never heard of their cutting it down. We would, therefore, have to assume that the adjustment of the inside rail always required raising. It does generally require raising, especially where you have very slow speed in one direction and high speed in the other.

Mr. Shurtleff: One of the members who is using this method on the Union Pacific is the chairman of the committee. On the reconstruction of the U. P. through Wyoming we did not find any difficulty in doing this. We did not find any difficulty in making our embankments or our excavations in line with this, but I cannot say as to the difficulty since then in maintenance. I know personally from having to handle track in my experience that a track foreman who can carry a gradient for several hundred feet around a curve is a dandy. If you do not find three inches difference in your

gradient on your inner rail, where you have no stakes, I am very much mistaken. The matter of carrying it into effect is no trouble whatever. We are speaking of building new lines. In such cases this can be done, and in many cases it can be carried into effect on constructed lines.

Mr. Courtenay: A number of years ago there was a wreck on the Old Colony road due to jacks being placed between the rails. On the L. & N. we have a rule prohibiting jacks from being used between the rails. Since it has been enforced it was found our section foreman could not reasonably put the lower rail to surface, but the jacks outside of the rail, toward the center of the curve, interfers with their line sight. Our foremen have universally adopted the rule of surfacing the outer rail by lifting it to proper surface with jacks, and then bringing the lower rail to surface with the level board. We some time ago adopted the rule requiring that the outer rail follow the profile, and the lower rail be depressed. In practice, for a number of years, with such methods as have prevailed on the L. & N. we do not find any serious difficulty about it. Our experience is that the lower rail goes down a great deal more than the upper rail. Our curves are elevated for passenger train speed, and, therefore, the lower rail gets excessive weights and requires more lifting and attention than the upper rail.

Mr. Lum: Mr. Shurtleff states that he has given such orders, but does not know how it is accomplished. How do you get the inner rail down when it is too high, as has been known to be the case? The one question is: How do you do it? I do not think it can be done as a practical proposition. Of course, you can do anything on a special occasion.

Mr. Camp: The practice which Mr. Courtenay described is not what the committee recommends. Mr. Courtenay states in his practice they keep the outer rail at grade. That is easily enough done, because he has the rail on a tangent on either side to go by, but where you put the outer rail half the elevation above the grade of the tangent on one side, and depress the inner rail half the elevation on the other side, that is where the difficulty comes in. It is easily enough done when you have the grade stakes, when the track is built. But I do not think you will find the track men will keep it there.

L. S. Rose (C., C., C. & St. L.): It has been my experience that we have to change the elevation a good many times, as the speed of trains increases. I do not see how that could be accomplished in this case unless you take the track down or raise the whole thing up.

Mr. Begien: I do not think it is a function of the committee to describe methods of maintaining the track. If we recommend what should be done, that is all that is in our province. On the other hand, I do not believe that it will be a very hard matter to maintain the track under these circumstances. It is not an unusual thing to take the track down in case of change of the superelevation. It is merely a matter of taking down the lower side and raising the higher side. If it is necessary to do that, however, and no doubt it is something to be accomplished in view of train resistances, I do not see why we should not keep stakes for the section men to surface by.

H. T. Porter (B. & L. E.): I have endeavored to place the vertical curves so they will come on the tangents. I am aware this cannot be done all the time, but as a rule it can be done. Then all the foreman has to take care of is the horizontal curve. You give him stakes set to straight grade for his inner rail, and he gets his track up in good solid condition. As a rule, he can keep the lower rail very close to the grade. The engineer can set the stakes exactly, but as a rule the foreman by experience can follow the grade closer than the engineer could if he undertakes to do it. I mean with the section gang, not with the instruments. Now, you could either follow the straight grade with your inner rail or your outer rail. I have always followed the straight grade with the inner rail. That simply leaves it to the foreman to put in the elevation called for, which he determines with his level board, so that it makes his proposition a simple one. If you have to lower the inner rail and raise the outer rail, you have three vertical curves in the inner rail and three vertical curves in the outer rail, and the foreman has nothing to guide him unless you furnish exact stakes. You must furnish stakes by which to surface the track the first time, but we are well aware that it is not desirable to maintain stakes along side the track at all times, on account of danger to the trainmen. Besides, a permanent set of monuments from 25 to 50 feet apart would be very expensive, and this would be necessary in order to have the foreman do good work with three vertical curves in both rails, as he can now with stakes for the inner rail set at the time he gets his track in good, solid condition.

I believe that the elevation of the outer rail does increase the resistance, but it only affects it on the short length of the train and the momentum readily takes care of this. It may produce a slight reduction of speed on entering the curve, but it is compensated for as you leave the curve, so that in the end there is practically no loss of speed.

Mr. Churchill: In view of the fact that conclusion 6 refers to general track maintenance, and in view of the fact that the committee has already presented us a rule for elevating rails on curves, and that this conclusion 5 affects the other, I move that it be stricken out.

Motion carried.

Conclusions 6 and 7 were adopted, with the addition of the words "and design" in conclusion 6, making it read, "condition and design," etc.

The secretary read conclusion 8.

C. H. Ewing (P. & R.): This is quite an important table. I have had to refer to it within the last few weeks is making a comparison of actual practice in adjusting for winter tonnage, and I was very much surprised to find so great a variance with actual practice the results obtained, as compared with the table prepared by the committee. It appears to me that the table is entirely too conservative. I have talked to some motive power men, who have made a number of experiments on this line, and they said that the reduction should not start above 35 degrees. I have found by starting at 45, and then going down to winter weather, say, 20 degrees, the reduction is very much greater than is usual in actual practice. If we start the reduction at 35 degrees with percentages given for temperatures 45 degrees to 35 degrees, it would approach more nearly the actual condition.

Mr. Fritch: I agree with what Mr. Ewing has said. The changes are too slight.

W. S. Thompson (Penn. R. R.): My experience is different from the last two speakers. The reduction is not enough. If it is calculated for double track, and trains moving constantly after starting, that is one proposition, but if the train gets in on the side track and waits ten, fifteen or twenty minutes, or an hour, you cannot start at zero degrees with the reduction you have in this table. I would like to ask what experiments are made on which this table is based?

Mr. Begein: This table represents the practice of the B. & O. This practice varies on the different divisions. I have known of cases where the temperature was about freezing, where, according to the division, it would call for 90 per cent, of rating where we were pulling 30. This is not a basis of tonnage rating, and is not intended to be such. It is a basis for comparing one line with another. If you can get the average temperature in any given locality on your line, we merely offer this table to show what per cent. of the calculated rating you can have the year around.

Mr. Fritch: I would suggest to the committee changing the last three or four words in the conclusion and make it read, "is submitted as information."

Mr. Ewing: In view of what the member of the committee has just said, if it would add to this conclusion that it is only intended for theoretical comparison between lines and not intended to apply to a tonnage rating of locomotives, I think that would cover the whole matter. It is confusing the way it is placed now.

Mr. Shurtleff: I believe the committee would consent to adding the words: "Is recommended for use in making comparisons of the economical value of locations or lines."

Mr. Ewing: I think the committee should make it a little more definite and say, "it is not intended to be made use of for tonnage ratings."

Mr. Fritch: I do not see how it would be useful in comparing various lines, because you cannot estimate what your temperature conditions will be in making comparisons. It is a very valuable matter, as far as information goes, but it will not fit the country generally.

The President: I understand that the committee will accept the suggestions which have been made.

Conclusion 8, as amended, was adopted.

Mr. McDonald: I move to reconsider the last vote. My reason for a reconsideration is that if we receive this part of the report as information we cannot put it in our Manual, and I think if we amended it at all, we should amend it as we want it, and then adopt it. I favor the idea of Mr. Ewing that we add to conclusion 7 that it be used as a method of working on a new line and not for tonnage rating.

Motion carried.

Mr. Begien: Perhaps some substitute can be offered. It is

very difficult, in a recommendation of this character, to get something to suit everyone. I think you will all agree that it is absolutely necessary to have some figures of this sort in comparing revisions, especially those extending over whole divisions. If we can have something to substitute, I do not think that the committee is at all anxious to use these particular figures. They certainly have worked out well in some cases.

Mr. McDonald: I move that conclusion 8 be amended as follows, by adding the words "incomparing new lines and not for tonnage rating."

Mr. Fritch: I cannot understand how you are going to assume your temperature under conditions where you are going to compare one line with another. You must assume some conditions. I do not see how it will be useful to you in making a comparison between the lines. It is, as Mr. Begien stated, almost impossible to make up a table of this kind that will be acceptable to everyone.

The motion of Mr. McDonald was put to vote and carried.

Conclusions 9 and 10 were adopted.

The secretary then read conclusion 1 as to curvature.

Several members objected to the word "safest."

G. A. Mountain (Can. Ry. Com.): I agree with the speakers who suggest an amendment. I do not think the word "safe" or the word "dangerous" should be used in any clause in the Manual whatever. It might be construed in a lawsuit, where an accident occurred on a curve, to mean that the curve was dangerous.

Mr. Shurtleff: The committee realizes the reasons for eliminating the word "safest." It brings up a point that I got a little excited about a while ago. In establishing values for curvature we have got to consider the question of safety, and railways are very diffident about giving out even to committees of this kind information with reference to the matter. After these conclusions have been considered, this committee would like to have suggestions from such operating or executive officers as are in the convention room, as to how we can get information that is necessary to establish these values.

After some further discussion, conclusion 1 was amended to read: "A straight line is the best alinement."

Conclusions 2, 3 and 4 were adopted.

Discussion on Wood Preservation.

Prof. W. K. Hatt (Purdue Univ.): Since printing the report some amendments have been prepared by the committee which will be offered to the specifications as printed. Some few amendments are also made to recommended practice.

The secretary read the General Requirements, from the specifications as printed.

Prof. Hatt: The committee wishes to add one clause to avoid an ambiguity, as follows: "The thoroughly air-seasoned ties shall be placed in the cylinder and a preliminary vacuum of not less than 24 inches of mercury shall be produced and maintained not less than ten minutes, at the expiration of which time the preservative shall be admitted without breaking the vacuum." That calls for a preliminary vacuum on air-seasoned ties to add the penetration and avoid subsequent drip. The specifications for the zinc-chloride treatment are substantially as printed in the Manual. The committee desires to add one clause, after the first sentence, as follows: "The cylinder shall be entirely filled with preservative and so maintained while the pressure is on, an air vent being provided by which the air in the cylinder and that coming from the charge while under pressure may be released.

The Zinc-Tannin treatment is substantially as written in the Manual, and there is no special comment to make upon it. The committee wishes it to be understood that the amendment calling for an air vent in the cylinder will apply to each of these treatments should be inserted after the first sentence under "Zinc-Tannin treatments" and all other treatments that are here recorded.

Under Creosoting the committee has called the ordinary processes "plain creosoting," to distinguish it from the modified processes which have been introduced in the last few years. The changes are as follows: Instead of specifiing a pressure of so many lbs. per square inch, the phrase "adequate pressure" is used. Instead of specifiing 10 lbs. per cubic foot, it should read, "the amount of dead oil to be injected shall be that provided for in the contract." The committee makes the following change in the first paragraph on page 317, by inserting the words, "on the same tank," after the word "taken," making the sentence read as follows: "The amount of oil absorbed shall be determined by calculation, based upon gage readings taken on the same tank before the introduction of the oil into the cylinder and after forcing the oil back after treatment." The committee has made a change in the specifications calling for the weighing of ties in and out of the cylinder occasionally. The sentence is as follows: "These should be checked occasionally by weighing the ties loaded under cylinder tram cars before and after treatment, the scale being inserted in the tram tracks." The committee also recommends a change in the last paragraph, which is that the amount of water accumulating in the creosote oil is limited to six per cent. instead of ten per cent.

The recommended specifications were approved.

The secretary read recommendations for the determination of zinc in treated timbers.

Prof. Hatt: The committee has another clause, No. 13, to add to these recommendations, as follows: "In order to judge of the penetration of the oil, borings should be made with a three-quarter to one inch augur, in not less than six ties in each cylinder load. The holes should be plugged with creosote turned plugs, with one-sixteenth inch larger diameter than the holes."

These recommendations were approved.

The secretary then read the conclusions, which were accepted.

Mr. McDonald: I think it is the function of this committee to prepare specifications for timber intended for treatment. We already have specifications for timber to be used without treatment, that is, in trestle work and matters of that kind, but we do need some directions or specifications as to the kind of timber that should be used for treatment, and the condition it is in. For instance, the amount of sap, and as to whether it is better to use long leaf yellow pine for piles or loblolly pine for piles. What I have in mind is that the more sap weight the greater the absorbing power of the timber. Is it better to rely on the treatment for durability than the natural condition of the wood, such as the heart yellow pine?

The President: The committee will take note of your suggestions.

The president then announced the result of the ballot for officers of the association for the ensuing year. The officers elected are as follows:

President, L. C. Fritch; Vice-President, C. S. Churchill; Secretary, E. H. Fritch; Treasurer, C. F. Loweth. Directors, three years each: Robert Trimble and F. S. Stevens.

Discussion on Ties.

The secretary read conclusions 1 and 2.

E. E. Hart (N. Y., C. & St. L.): The roads do not respond in furnishing this information.

Mr. Downs: There were about 750 inquiries sent out asking three simple questions. One was as to whether or not they had used the blanks that had been gotten up by the committee. Another was, if they wanted to use them, and another if they favored a count of the ties. A postal card was enclosed, so that all they had to do was to answer Yes or No. A surprising thing was that there were only 45 replies received out of that number, which shows the very little interest taken in giving the information we are trying to get. So the committee intends to take it up individually with those whom we know to be interested in tie statistics, outline certain questions that they can answer very easily, and by next year, I think, we can get some information that will be of interest to the association. We still believe, however, that the blanks are a good thing and the whole committee think that if they are kept by roads indefinitely they will in time have information on those blanks that will assist them materially.

E. O. Faulkner (A. T. & S. F.): We have given a good deal of attention to that subject on the Santa Fe for the last five years and the trouble is that owing to the frequent changes in section foremen and the fact that that class of labor is not of the highest class, in the West especially, we find it very difficult indeed to get any records which at all approximate the correct condition of the treated ties in the track, or untreated ties, either. Our practice is to put a round nail in treated ties and a square nail in untreated ties; but in spite of instructions, in spite of supervision, we find we cannot get correct statistics. I have recommended to our people that, instead of attempting to keep watch over 1400 sections, we take on each superintendent's division one, two or three representative sections, and keep good men in charge. We can watch that a great deal easier than we can the larger number and in that way approximate generally and much more accurately than we do at the present time the life of the treated and untreated ties which are in our track. I was interested in noticing in the bulletins that other companies have found the same difficulties as we have, and practically suggest a similar plan, and I hope yet that this will be carried out. While we are all doing this wood preservation, it

really is an essential fact to know what result we are getting from it; but when we get reports which we know do not at all reflect the actual conditions in the track, those are really worse than having none at all. If we had no reports, the roadmasters and others would take observations there themselves, instead of relying on our statistics. It has always seemed to me that the Tie Committee asks too much, and therefore does not get anything. I believe if the committee would send to the roads and ask them a few leading questions, such as the different ties they used, the approximate average life they get, both treated and untreated, and any other information that is generally kept, we would get something to base comparisons on. I think nearly 180 questions are asked now from each individual system, and it is worse than keeping statistics for the Interstate Commerce Commission. I shall cooperate by giving whatever statistics I have in my department. There are a number of experimental pieces of track changes of line, for instance,—that I am sure the roads would be glad to give the committee if their attention were called to it.

Mr. Downs: Mr. Faulkner probably misunderstood me in saying that we were asking too much on the blanks. We did not send out the blanks this year to be filled in, but we sent out a letter with a postal card reply, asking three questions, all of which could be answered by Yes or No.

O. Chanute (Con. Eng.): I agree with Mr. Faulkner, that if you ask too much you get nothing. It is, however, quite possible for the committee to boil down the list of the inquiries so as to obtain valuable results. That was done 25 years ago by a committee of the American Society of Civil Engineers, which occupied five years in gathering data as to the preservation of wood. They began much in the same way which this committee did this year, by asking a very few questions as to what information had been obtained, what had been the results up to that time, and who else might possess information. The answers received disclosed that a number of people throughout the country had had experience, and those gentlemen's lives were made miserable by correspondence until we managed to get out of them what they knew, and what they recollected. The result was the report of 1885 to the American Society, which I believe inaugurated the treatment of wood in this country.

Conclusion 2 was adopted.

The secretary read conclusion 3.

Dr. Herman Von Schrenk (R. I.- Frisco.): The tree planting proposition for tie supplies must be considered very much in the light of a banking proposition. It represents a certain invested capital, from which we must obtain, sooner or later, a certain definite interest return. The practicability of making a large investment to start with in planting trees will be determined by the cost of land, the cost of planting trees, maintenance charges, and the probability of a certain definite return after a comparative brief period of years. Up to the present time, with very few exceptions, private indivuals or an aggregation of individuals, have found that the investments of large sums of money in lands in the purchase of trees and their proper maintenance has not been a paying proposition. My personal view is that it a very much better plan for a railway which desires to assure a future supply to buy standing stumps. One can still find in many parts of the United States forest lands in regions, which so far as we can foretell, will not be distinctively agricultural in the future. A company can buy the standing forest trees and protect them against fire, and the natural reproduction which takes place in the forest will obviate the more or less expensive replanting of new trees. I know of one road that has recently gone to a scheme of that sort, and purchased a large tract of pine land in the south, which will be operated very economically by cutting out the mature timber, and thereby giving the young timber a chance to grow. If any plan is determined, an important part is the employment of capable men to continue such a plan and, above all, a suitable fund to make possible a maintenance which will bring the matter to a successful conclusion.

Conclusion 3 was adopted.

Discussion on Ballast.

The secretary read conclusion 1:

Mr. Cushing: The official term is stone ballast, as approved by our Manual, and not rock ballast.

The President: That change will be made.

Mr. Lindsay: The committee in another portion of the report has touched very properly on the quality of toughness in the stone suitable for stone ballast. Is that quality of sufficient importance to insert a reference to it in the specifications? I also ask if the words "when crushed" are necessary?

Mr. Hanna: In regard to toughness, the committee has not covered that in a recommendation in connection with tests of stone to be used for ballast. The view that the committee has taken of that is that it is hardly the proper place in the specifications to cover that characteristic of stone. The question of the preparation of ballast, the conditions that the roads have to meet, the selection of a suitable ballast, involves tests or some method of ascertaining the suitability of the stone. It has seemed to the committee that that phase of the subject was sufficiently covered when the committee recommended tests for stone, and published one of those tests. We think that no good object is accomplished by enlarging the specifications to cover this feature of toughness. In selecting stone for ballast, the quality of toughness would be a relative one, that would be determined by the tests when a road was in a position to choose between different stones. As to whether the words "when crushed" are superfluous, it seems to me proper to include these words in the specification simply for the reason that it is possible that a stone would break in angular pieces under the hammer. What we are concerned with as a commercial proposition is the way the stone will act in a crusher.

Mr. Hanna: In the second clause under Revised Specifications for Rock Ballast, the members will notice a change. We now say: "2½-in. test ring." In the specification in the Manual, we state "shall not exceed pieces which will pass through a screen having 2-in. holes." The use of the test screen in this connection is intended to make the size of the stone more definite. It is brought out in some of the replies to the committee's circular that the use of a screen with holes of a certain size does not make it follow, as a matter of necessity, that the average of the stones are of that size.

Robert Trimble (Penna. Lines): On page 96 of the bulletin is a quotation from the specifications of the Pennsylvania Lines West. The quotation was correct at the time it was given to the committee, but since that time we have changed our specification and we changed the minimum hole of the screen from ¾ of an inch to 1 inch. The trouble with a minimum hole of ¾ of an inch is that you get ballast that is quite small, and under ¾ in. in dimensions, and we found we were getting a large amount of small stone. We therefore changed the hole in the screen for the minimum size.

The secretary read conclusion 2.

H. R. Stafford (I. C.): What is the basis of the classification referred to? Is it the same basis that was adopted some years ago in the Manual in reference to the work of the Committee on Ties and the Committee on Track?

Mr. Hanna: Yes.

Conclusion 2 was adopted.

The secretary read conclusion 3.

Mr. Hanna: By an oversight, the tests recommended were not printed in bold-faced type in the bulletin. You will find on page 87 the tests recommended.

The secretary read the matter referred to.

Mr. Cushing: Does the committee consider that the crushing tests are of no particular value in testing stone for ballast, and that these tests were designedly left out?

Mr. Hanna: Yes. A letter received since our report from the director of public roads, Mr. Page, says: "This office has not made a practice of making crushing tests on road materials, for the reason that we have never been able to discover any relation between the crushing strength of a rock and its behavior on a road surface." As is stated in the report, these tests were undertaken by the Department of Agriculture as one means of encouraging good roads. They have not been heretofore undertaken with a view to determining the value of stone for ballast. I think perhaps it is a debatable question whether the crushing strength might not be a desirable thing to determine.

Conclusion 3 was adopted.

The secretary read conclusion 4.

Mr. Lindsay: I would call attention to the fact that Congress has passed a law requiring that all locomotives shall be equipped with ash pans, which can be dumped without the necessity of a man crawling under the engine. The old style ash pan did reasonably well in keeping the ashes in the pan. With the pan equipped with the automatic dumping feature, the normal position of the pan is open, and the ashes go directly on to the track. Track men will soon find a marked increase in the necessity of cleaning stone ballast, and it is going to show in the expense accounts.

Mr. Begien: The statement is made: "Clean between ties to bottom of ties." I do not think that is deep enough. It is our practice to clean the ballast five inches below the bottom of the ties for the purpose of cleaning the base on which the tie rests. I think this clause should be amended so as to state some distance below the bottom of ties, say five inches below the bottom of the ties.

C. H. Fisk (Con. Eng.): As to the statement, "Per cent. of new stone ballast to be applied—15 to 25 per cent.," when is that to be applied?

Mr. Hanna: Whenever it is cleaned.

H. R. Stafford (I. C.): We have had occasion to clean in the neighborhood of nearly 100 miles, I should say, of ballasted track. The cause for that cleaning is largely due to the fact that a portion of one quarry from which we had obtained ballast contained a rather soft stone. The necessity for cleaning was due to the disintegration of the material, and our practice was to clean the ballast to the bottom of the ties. We considered going below the bottom of the tie, but that could not be done, of course, between the ties and would leave a bed of clean ballast on a trench, as it were, of dirty material and would tend to hold the water. It would be cheaper in the long run for us at the time we cleaned to leave that bed undisturbed at the base of the tie, and put in sufficient new ballast, in addition to the ballast cleaned and thrown back, to raise the track some four or five inches. It was our opinion, based on tests, that some element of damage resulted in cleaning out the ties to a depth lower than the bottom, and results that we procured subsequently were very much better.

Conclusion 4 was adopted.

Discussion on Track.

Mr. Rose: In addition to the report as printed, the committee recommends the withdrawal of six paragraphs under the heading "Inspection of Track," on page 66 of the Manual. As explained yesterday, when the Committee on Uniform Rules presented its report, these six paragraphs are now covered by the Uniform Rules Committee.

The secretary read conclusion 1.

Mr. Mountain: I notice under Maintenance of Gage that the committee only alludes to spikes at the outside of the rails on curves. There has been a good deal of use of the other fastenings of rails to ties, and I would ask the committee if it has any recommendations to make, such as the screw spike. I judge it refers to the ordinary cut spike in all its recommendations.

Mr. Rose: The committee has made no recommendations concerning any special kind of spike, and it has not given the matter any consideration. This is merely a revision of the Manual, worded slightly different from what it appears in the printed portion of the Manual, covering shoulder tie plates. The old recommendation did not specify shoulder tie plates, and that was the principal reason for rewriting these recommendations. This is for very light traffic.

Mr. Downs: I wish to refer to clause 8, under Maintenance of Gage, the last sentence, in which it says: "Under ordinary conditions it is not necessary to regage track if the increase in gage has not amounted to more than one-half inch, providing such increase is uniform." I think the Rail Committee will take exception to that, especially on curves, where the wheels tend to go to the outside curve, causing worn flanges to be up on the rail on the inside, causing the rail to flow. The rail will be materially damaged when the gage is a half inch wide on curves, and I do not think that should be in the Manual.

To make clear what conclusion 1 covered, the secretary read the clauses under Maintenance of Gage, to and including clause 7.

Mr. Brooke: I ask the committee why it would use two spikes on the outside of rail on curves under light traffic and make no mention of that feature under heavy traffic?

The secretary read clause 8.

Mr. Cushing: I am opposed to that change where it says it is not necessary to regage the track if the increase in gage has not amounted to more than ½ in., providing such increase is uniform. It is now ⅜ in. in the Manual.

Mr. Rose: That was adopted last year and changed to ½ in.

Mr. Cushing: I am still opposed to it. I move that it be made ⅜ in. instead of ½ in.

H. G. Griswold (Ill. Steel Co.): I have had some experience with wide gages. I find with a ⅜ in. increase it causes flow of the inner rail. The wide gage also allows the lead wheels of trucks to get in greater angularity with the outer rail and increases flange wear.

Mr. Camp: If the track is ⅜ in. out at a switch, it would be too wide even though it is uniform.

Mr. Rose: I would like to refer to some letters we got on that question. One gentleman asked how we would get an engine through a switch with eight-foot wheel base, and all flanged drivers. We would have to widen the switch.

Mr. Camp: Would you widen the main track?

Mr. Rose: Yes.

Mr. McDonald: I think the tendency is toward the use of a spike in treated ties that will as far as possible preserve the ties. Mr. Kendrick last night pointed out to us very clearly the destructive effect of driving spikes in a tie. Every time you regage the track with the ordinary driven spike you destroy that much more life of the ties. Where you use screw spikes it seems almost impossible to shift the rail back to its standard gage without very serious injury to the tie. My experience has been, where I have used screw spikes that rather than shift the rail on the ties I have found it better to change the rail, and I think we are entirely within safe limits in allowing that rail to wear at least ¾ in. before we change. I think we should go slowly on this proposition.

Mr. Roberts: I do not think it is the intention of the committee to recommend to the various roads that they let their track go ½ inch wide gage, but simply to place a limit beyond which they should not go. I think it is the general opinion of the committee that a good trackman will keep his track at all times as near as possible to the correct gage.

W. S. Thompson (Penn. R. R.): Would not a foreman, when he knows he is allowed a ½ inch wide gage, allow his track to stay there, instead of regaging, and would not a wide gage tend to make your track spread wider, due to the oscillation of a train passing over a wide gage?

Mr. Rose: It is not the intention to have these rules for the track foreman, but as a recommendation for the engineers.

The President: Gentlemen, you have heard the motion to change the increase in gage, as given in clause 8, from ½ inch to ⅜ inch.

The motion was lost.

The secretary read clauses 9 and 10, which were passed without change.

Conclusion 2 was adopted.

The secretary read conclusion 3 and the accompanying matter under the heading Specifications for Springs and Rigid Frogs.

F. S. Stevens (P. & R.): This specification calls for general dimensions. I move that we should substitute "full details" for "general dimensions."

Mr. Rose: There would be a lot of roads that would not have any one to make these details, and the manufacturer is better able to do that than the railway companies.

Mr. Stevens: How is a frog to be built on general dimensions?

Mr. Fritch: I think that the committee is wise in specifying General Dimensions. If you go into the details of this matter you will have as many plans as there are individual roads in the country. I think we should agree upon "general dimensions," and I believe it will simplify the manufacturer of frogs and switches very much.

Mr. Stevens: I do not mean the details of any general plan, but the details furnished by the company which is buying the material. I move that the words "full details" be substituted for the words "general dimensions," with the explanation I have made it refers only to the plans of the company ordering the material.

Mr. Fritch: Referring to the clause at the bottom of page 176, reading as follows: "Where there is material leakage from track circuits, track fastenings should be so designed as to prevent contact between the metal and the ballast," how that is to be accomplished in the case, say, of a 100 per cent. joint, where the reinforcement extends below the top of the tie?

Mr. Rose: You will have to use some other joint or cut the ballast down. My understanding is that in some classes of ballast there is no leakage on the track surface, but with cinders and with slag there is considerable leakage. You cannot maintain the track circuits when you have contact between the ballast and the rail.

Mr. Fritch: I think there would be very serious objection to having pockets in your ballast, to cut the material away from the joint. Furthermore, on tracks provided with track circuits, the ballast is usually of another class than cinder ballast. I move that that clause, which was included in the adoption of conclusion 1, be reconsidered.

Mr. Begien: On lines that have track circuits, a great many of them also have sinks, and these sinks are almost invariably ballasted with cinders. The trouble which we experience from currents and short circuits in cinder bal-

lasted track are very noticeable and we make a practice of putting angle bars on all tracks across sinks where cinders are used.

The secretary continued to read the Specifications for Spring and Rigid Frogs.

Mr. Cushing: I would like the committee to remove the word, "coöperate" in the first line of the third paragraph.

The President. The committee will accept that.

Mr. Ewing: I wish to speak to the section which reads: "Raising blocks must be of cast steel." I understand that many frog companies are using raising blocks made of sections of rail, rolled steel.

The President: This is a recommendation of the commitee for the best practice.

Mr. Ewing: In the section on "bolts," I suggest the elimination of the words "United States Standard," for the reason that there are today special bolts used in the construction of the track, which have special heads, which are very much better than a standard head.

Mr. Rose: The committee wanted to recommend a square head rather than an hexagonal head. You get a better arrangement.

Mr. Ewing: I do not refer to the hexagonal. I refer to a special square headed bolt that fits the rail and prevents turning. A United States standard square head is one which requires you to use special washers. In place of the standard head bolt, there is a special head bolt made, which is better than the standard head.

The President: The committee will accept that.

Mr. Brooke: I would like to go back to paragraphs 3, 4 and 5 under Maintenance of Gage. These paragraphs contain recommendations as to the use of tie plates on lines of heavy traffic, medium traffic and light traffic. In the Manual on page 277 we have a classification of track, Class A, Class B, and Class C, which were formulated by a special committee and accepted by the association. Could not these classifications be used in paragraphs 3, 4 and 5? It seems to me that would make the practice of the association more consistent.

The President: This has already been passed, do you wish to reopen the subject or do you wish to ask the committee to classify these roads?

Mr. Brooke: I move to reopen the subject so that these changes can be made.

Mr. Roberts: As a member of the committee, I object to the change suggested, for the reason that you might have Class A track for light traffic. The classification of the track does not entirely govern the traffic you have over it.

Mr. Brooke: This classification of the track in the Manual definitely states a minimum of traffic on Class A track. I move that for the words "heavy traffic," in paragraph 3, the words "Class A track" be substituted; for the words "medium traffic," in paragraph 4, the words "Class B track" be substituted, and for the words "light traffic," in paragraph 5, that the words "Class C track" be substituted.

The chair ruled that the motion was out of order.

The secretary read the balance of the clauses, under the headings "Workmanship," "Inspection" and "Requisites for Switch Stands."

Mr. Churchill: I object to clause 5, under "Requisites for Switch Stands," where it is provided, "Ground stands should be provided with latches which work with the foot." That is liable to compel the use of a particular form of stand. I think there are plenty of ground stands that work as well, and we should not tie this association up to a particular shape of stand, such as is used in ordinary yards.

The President: Do you offer that as a substitute?

Mr. Churchill: I move that it be omitted entirely.

Mr. Rose: I know of two or three concerns which make latches which are worked by the foot. The committee was not aware that we were running into any patented device. We were trying to look out for the one-armed switchman.

The motion of Mr. Churchill was adopted.

The secretary read conclusion 4 and the accompanying matter relating to frogs and switches.

Mr. Rose: The committee desires to change the recommendation slightly in regard to frogs and switch points. It is now as follows: "22-ft. switch points with frogs over No. 10, up to and including No. 14," and "33-ft. switch points with frogs over No. 14." We desire to change the first one to read, with frogs over No. 10, up to and including No. 15; and we desire to change the second one to read, with frogs over No. 15, and the table will be changed accordingly.

Prof. Allen: As far as conclusion No. 4 is concerned, I have no desire to make any suggestions as to the substance of the table. But in one matter of form, I think it is perhaps of sufficient importance to take the matter up. I notice that the frogs and the degree of lead curve, and the switch angle, are all given in seconds. It seems to me that is unnecessarily fine, and I would like to suggest to the committee that the nearest minute be used instead of seconds, if that meets with the approval of the committee.

Mr. Roberts: We were asked to give, first, theoretical leads for the given switch rails, frogs and gage, so in giving those theoretical leads we worked to the second, but I do not believe the committee means to recommend that all roads require the frog builders to build their frogs or their switch rails to seconds. We agree with Mr. Allen that if they build them to the nearest minute they will do very well, but for the sake of the table, we believe the table is correct, and that the distances as given in this table will be as nearly right, owing to the inaccuracies of the frog, as if you worked to the minute. The frog may be a little less or a little more, and that is probably a happy medium, as if we had taken it to the minute.

Prof. Allen: I do not object to their getting three figures through the use of seconds, but it seems to me that in the incorporation of the table in the Manual a false idea is given. It seems to me that it conveys an impression of precision that is altogether inappropriate for the things we are dealing with. A frog, I presume, cannot be, or generally is not, made closer than perhaps five minutes, and it seems to me that the position of the association would be more fortunate if these figures were presented simply to the nearest minute, although in the intermediate process the use of seconds may have been somewhat valuable.

Mr. Ewing: I would like to ask the committee if there are any roads using 33-foot switches?

Mr. Rose: Yes; we are using them on the Big Four.

Mr. Ewing: Does the committee consider it good practice to put a joint in the stop rail, in the body of the switch?

Mr. Rose: That is a question the whole committee has not discussed, but personally I will say yes.

Mr. Ewing: I would like to ask the committee if it can be done with the use of ordinary joints. Will not special joints have to be used?

Mr. Rose: Yes; you would have to trim the bar.

Mr. Ewing: For that reason they are very objectionable, and I would say a 33-foot switch should be eliminated and a 30-foot switch substituted to get rid of troubles of that kind, which are of quite a serious nature.

Mr. Begien: I think a 60-foot rail is in common use at such points.

Mr. Rose: I would like to tell Mr. Ewing how to get rid of his trouble. Space the joints so the angle bar will come near the heel of the switch, where the spread is sufficient to take care of it.

Mr. Ewing: As I understand the committee, with 6½-in. spread at the switch, which is the least distance that it is possible to get a standard angle bar, if you move the joint back you have got to move it back at least 2 ft. 6 in. to properly clear the angle bar at the point of the switch.

Mr. Rose: The heel distance of these switches has been so arranged that an angle bar 36 in. long can be used and some patented joints that have wide bases can be applied also by putting in an angle bar of shorter length. I think you can get it in there all right.

H. P. Porter (B. & L. E.): The 33-foot switch was suggested by the committee on account of it being the standard length of rail. We have several 33-foot switch points. We haven't got them all in, and at the joint you can shear off the angle bar even with the base of the rail. That can be done in the ordinary shop and at a very small expense. I believe the spacing at the heel of the switch point is such that you could get a 5-inch spike between the bases of the two rails. A 30-foot rail is not the standard rail now, and you would either have to sort out or else waste 3 ft. on each rail, when you have your switch point made, for which you would have to pay and for which you would have no return.

Mr. Ewing: I think Mr. Porter is a little mistaken in that. The Rail Committee says the standard length of rail is 33 ft., but at the same time the Rail Committee permits the acceptance of rails 30 ft. in length, and it is possible to get all the 30-foot rails you need to cover all your switch requirements.

Mr. Porter: Switches are supposed to be made only of first quality No. 1 rails, and I think you can get them without having them sorted. I wrote to practically all the large rail manufacturers in the United States and their reply was that anywhere from 92 to 99 per cent. of the rails they rolled were 33 feet; that a 30-foot rail was not called for.

Mr. Ewing: I should like to go back to the subject under discussion, the length of switches. In view of the admission

on the part of the committee that this type of construction requires a weak point in the main track rails, by cutting off the angle plates at the joint, I move that the standard length of the longest switch be 30 feet, instead of 33 feet, and that this report be referred back to the committee for revision.

The President: You mean that part?

Mr. Ewing: That part which would carry with it the tables.

Mr. Porter: I would like to know how much spread would be necessary to allow your full angle bar.

Mr. Ewing: The main factor of using a long switch is to decrease the angle in the switch so that trains can run over it at the highest rate of speed possible. In view of that, you ought to get the minimum distance at the heel of the switch that it is possible to obtain and get on your standard track construction.

Mr. Roberts: The committee would be very glad to revise this table, the latter part of it especially, and cut out the 33-foot switch rails. We agree with you that you ought to reduce the distance. We also agree that whether you use 30 or 33 foot switch rails you have to clip the angle bar. If the convention will approve cutting down the heel distance and using shorter switch rails, I believe you will get better switches, have less long, unsupported length of switch rails; but last year and prior to that time the convention did not approve of using the smaller heel distances.

The President: Mr. Ewing's motion is that conclusion 4, with the accompanying tables, be referred back to the committee for further consideration. That will take care of Prof. Allen's matter too.

Prof. Allen: I understand the committee accepts that change.

Mr. Rose: For practical leads.

Mr. Ewing's motion was lost.

Mr. Rose: The committee has no objection to leaving off the seconds in that portion of the table under practical leads for the switch angles, frog angles and the degree of curve.

Mr. Osgood: I notice the length of the switch points favored here include 11 feet, 16½ feet and 22 feet. I take it that they are so fixed because the rails are ordinarily 33 feet in length. I would like to inquire if it is not a fact that at the present the vast majority of switch points are 15 and 20 feet, or some such lengths, and that at present there is a comparatively small number of lengths of 16½ feet and 11 feet. I know that in my part of the country we use 15 feet and 20 feet and have none of the lengths mentioned here.

Prof. Allen: I move that in these tables the frog angle, the switch angle and the degree of allowed curve shall be amended so that they will be shown to the nearest minute.

Mr. Ross: The committee does not feel that it should cut out more than the seconds on the track lead.

The motion was lost.

Conclusion 4 was adopted.

The secretary read conclusion 5.

Mr. Lum: I suggest that the words "four degrees" be substituted, and that the increase be made as suggested further on in the paragraph. If I understand the second clause, it is proposed to widen the gage where the curve exceeds eight degrees, but if there shall be a frog in that curve it is to be brought down to the 4 ft. 8½. This does not seem to be consistent, as it would be easier for the train to pass through the curve where there is no frog than it would be for it to pass at the throat of the frog. I move a change from the words 8 degrees to 4 degrees in the first clause and a change in the second clause permitting the widening of the gage at the frog, providing at that place a difference in the guard rail clearance.

Mr. Rose: It is not necessary to widen the gage on four-degree curves with the present engines. The rule is based on calculations made by the committee submitted last year and also on replies from over 40 roads. It was found that the committee's calculations and the replies came very closely together. That is the reason we begin with 8 degrees. The second part of Mr. Lum's motion refers to widening the gage of frogs. We admit that it will introduce some resistance, but we say that the installation of frogs on the inside of curves is to be avoided wherever practicable. This applies to frogs on the inside only; with frogs on the outside of the curves we would widen the gage just the same. The reason for that is that we will have to widen the flange way of the frog in order to take care of it, and we will get our wheels on the flangeway passing through the fillers.

Mr. Lum: It was not suggested that you widen the flangeway through the frog, but widen the flangeway through the guard rail. That gives you the proper clearance for a widened gage at the point of the frog, and in that way you maintain your consistency in spreading the gage for the sharp curve, instead of spreading it through its general length and then reducing it at the point of the frog.

Mr. Lindsay: Assuming an 8-degree curve on a high speed track, with the frog in the low rail, it is true that we can provide for the passage of the pair of wheels there by maintaining the proper distance between the frog point and the guard rail on the opposite side of the track; but assuming a train passing through there at the speed for which the curve is elevated, or a higher speed, the flange striking the wing rail frog, is forcibly pulled down hill by the amount that the gage is widened, and it throws a tremendous strain not only upon the frog bolts, but upon the flanges and the wheels, and increases very materially the danger from fracture of the flanges or breaking the axle.

Mr. Camp: I think the committee is perfectly right in regard to the second part of this resolution. Where you have the frog on the inside of the curve, you have the guard rail on the inside of the curve; that is to say, the wing frog constitutes the guard rail, and it is a short guard rail at that. If you widen the gage, every wheel passing through the curve is going to hit that guard rail hard. I have seen that.

Mr. Osgood: Isn't the logical way to take care of that to widen the flangeway of the frog? I have done that in some instances.

The amendment proposed by Mr. Lum was lost.

Conclusions 5 and 6 were adopted.

Discussion on Masonry and on Standard Specifications for Cement.

The report of the Special Committee on Standard Specifications for Cement was accepted.

Mr. Wendt: I would like to ask, whether Appendix A, in the report on Masonry including all these specifications, has received the unanimous approval of the committee.

Mr. Cunningham: It is unanimous.

The matter in Appendix A regarding concrete materials was adopted.

Mr. McDonald: I would ask the committee if they anticipate any trouble in securing re-enforcing steel with 60 per cent. ultimate. I recently had to place an order under that specification and I finally had to compromise on 55 per cent. and the work was delayed for five weeks and the factory said they couldn't furnish it without making a special arrangment for it.

Mr. Cunningham: This is the same specification that has been adopted by the convention for structural steel. It is in the Manual.

Mr. McDonald: Having taken it out of the Manual and having this trouble about it, I doubt the expediency of putting it in here now.

The matter on Steel Reinforcement was adopted.

Mr. Cunningham: I want to call attention to something the committee wishes to insert on page 11, next to paragraph 46. It was left out for some unknown reason: "The reinforcement shall be carefully placed in accordance with the plans, and adequate means shall be provided to hold it in its proper position until the concrete has been deposited and compacted."

The matter on Workmanship was adopted with this addition. The other conclusions of the report were also adopted.

Mr. Cunningham: The committee made a recommendation, conclusion 5, which has been inadvertently omitted. It reads: "That the report of the Joint Committee on Concrete and Reinforced Concrete be received as information and be printed in the proceedings."

This conclusion was adopted.

KERITE INSULATED CABLES.

The Kerite Insulated Wire & Cable Co., New York, in space 61-62, has a very interesting display of Kerite insulated wires and cables. Several samples of insulating tape, made by the company some 15 years ago, demonstrate the fact that this tape does not deteriorate with age, the samples shown being as good as new.

Mounted on a board is shown a sample taken from a section of nine miles of cable manufactured for the Western Union Telegraph Company. This nine-mile length was shipped, on March 5, to be used in replacing a section of English cable across Puget Sound, Washington. There is a section of the present cable which will remain in place and to which the

new section will be spliced, when the entire cable will be Kerite.

A section of the Colon-Panama cable is also shown. This cable was made in one length of 50 miles in November, 1908, shipped to the isthmus intact on 16 flat cars chained together. When it was laid, however, it was necessary to cut it into sections and resplice the joints. During the construction of the canal the cable will lay along the canal route, in some places above and in others below the surface. During this time the cable is being subjected to very severe temperature conditions. When the canal is completed, it will be laid along the canal bed. This cable was put into service in December, 1908, and it is considered one of the most important cables extant, connecting, as it does, the Atlantic and Pacific oceans.

The contract for this cable was given to the Kerite company, said to have been the highest bidder, after a careful investigation of then existing installations in the United States and Europe. The cable has four copper conductors of 7 strands each. The conductors are insulated with Kerite, making each 8/32-in. diameter outside of insulation. Each core is marked for tracing and covered with lead 4/100-in. thick to prevent induction when submerged. In making this cable is laid up in spiral formation, then jute laterals are placed, after which it is taped. It is then again juted, after which the armor, of No. 8 B. W. G. galvanized wire, is placed. Additional jute, in two reverse layers treated with a preservative compound, is then placed.

ANNUAL DINNER.

The eleventh annual dinner of the American Railway Engineering and Maintenance of Way Association was held Wednesday evening at the Congress hotel. The attendance was about 300. President McNab was a highly efficient toastmaster and the proceedings were enlivened by excellent music, singing, and a few well-selected vaudeville specialties.

The speeches, which were received with much enthusiasm, were as follows:

President McNab.

The office of President would not be worth very much unless the encumbent enjoyed some privileges or prerogatives. One of these prerogatives is that he sometimes can do as he pleases, or rather that he can do what pleases him, and on that account I am going to begin my address tonight in a little different manner from what is customary at an assembly of this sort of our members, and I am going to address the ladies first.

Ladies, members of the American Railway Engineering and Maintenance of Way Association and guests: —(Applause.) I am very pleased to welcome you on this social occasion. I am sure it is the consensus of opinion of the members of this association that our banquets in the past have been ideal. I do not mean altogether on account of the procedure or the material comforts enjoyed, but by reason of the flow of wit, the rhetoric, philosophy and after-dinner shop talk that we have had such an abundance of, and I am very pleased to see tonight that there is no indication that the lustre which has surrounded these festive occasions is going to be dimmed.

I suppose that if we were all Scotchmen it would be perfectly legitimate for us to rub each other on the back and praise one another for all the great and glorious things that we have done in the past, not only ourselves but our fathers before us, but as we have not all that honor—(Laughter and applause.)—I am just going to say seriously —(renewed laughter.)—oh, some of you have the honor—that if you search this continent from the Atlantic to the Pacific, and from the Gulf of Mexico to the Pole, either discovered or undiscovered (Laughter) you will not find a body of men, who, in business session, apply themselves with greater zeal, assiduity, and earnestness of purpose than do the members of this association. (Applause.) I will say here that, phlegmatic as engineers are supposed to be, I know of no body who can enjoy a social function of this kind on a higher plane than do our members.

Now, gentlemen, I hope that the pleasures of anticipation that you have had in regard to this banquet will only be exceeded by the joys and happiness of realization. (Applause.)

The company then sang "God Save the King."

President McNab continued: Ladies and Gentlemen: Adjoining this country on its northern boundary, and extending from ocean to ocean is a land which today for good reasons, perhaps enviable reasons, is in the limelight of universal public interest. Evidence that nationhood, with all the mighty import that that term implies, is assuming considerable proportions in that country is not difficult to find. Clearing of the virgin forests (there are none in this country, gentlemen, but there are still some over there), settlement of the prairies, the development of water power with which that country is liberally blessed, the establishment of industries and commercial relations with other countries, the opening up of mines, and, last to be mentioned but by no means least in importance, the question of transportation, is being forced upon that country, naturally forced upon that country, and is being dealt with by master minds of that art, and with all the vigor and foresight with which they are so liberally endowed.

There is a great department of the government in Canada known as the Department of Railways and Canals. It is presided over by a minister of the Crown, who for the time being is Master of Transportation, if I may use that word in its broadest sense, Master of Transportation of Canada.

We are fortunate in having with us tonight the Hon. George P. Graham, the Minister of Railways and Canals (applause), and I wish io express, as the president of this association, my personal appreciation of the kindness of Mr. Graham in leaving his parliamentary duties and coming all the way from Ottawa to Chicago. But, notwithstanding that, I want Mr. Graham to know that there is such a thing as reciprocity, and I want him to feel that despite his coming that distance and leaving his parliamentary duties, he has come to a place where he can feel that he is going to get much good from his visit, and I am sure Mr. Graham will take my statement in its kindest way.

I have very much pleasure in introducing to you Mr. Graham. (Applause.)

Hon. George P. Graham.

Mr. President, Ladies and Gentlemen: It is a considerable relief to me that the ladies are present, because I am told that the president is a veritable story teller; he will not tell them tonight. (Laughter.) I am not sure, now, ladies, addressing you particularly, that I can say anything that will be of interest to you. It was not always thus. (Laughter.) I do not pretend that I was ever any kind of a success where there were a number of ladies, but I have made progress where the audience was confined to one (laughter). However, I am sure, sir, that we are all delighted to have the ladies with us, and if I could take advantage of my transportation facilities, as the president says, I would do so for the purpose of trans-

porting myself to the gallery. (Laughter.) Not by the long-haul route, but by an air line. (Laughter.)

Now, sir, it is a great pleasure for me to come from what you call my parliamentary duties to meet those who are engaged, as I am, in working out the transportation problems of this country,—I in my sphere and you in yours. But, like railway engineering, there is always a compensation, and it is a great relief for me to come here and get away from parliamentary duties.

I am a little inclined, sir, to be somewhat timid, in coming from a small town and being dropped in the center of a great city like Chicago; but, surrounded by a body of men who are fellow-workers with myself, I am not so much alarmed as I might be; and, further, I am told there are 50,000 Canadians in Chicago, and I feel I can have somebody to depend on in case of stress. I have sympathy, of course, with the men who belong to this association. Our universities in Canada, possibly, have been a little slow in taking up the practical work which pertains to your calling; but they are falling in line now and our universities are being equipped for giving the technical education that is required for the practical lives we have to live to-day and the practical work we have to do. It is a great pleasure for me, although it has its compensations, however, in the fear I have in having a president of a university so close at hand. I feel, sir, there will be no wit and empty rhetoric, but common shop talk in what I have to say. The Engineering Department, as I heard them discussing to-day the question of elevation and grades and compensations, reminded me that some people are moral enough to say that politicians have curves. Others go so far as to say that there is no compensation to the public for those curves. (Laughter.) I am not sure whether that section 4 you were discussing to-day so learnedly would apply to that remark or not. Then, too, sir, we have our up grades of public life, just as you have in the transportation problem. But to my mind the most moral of all the departments of railway construction is the Maintenance of Way Department, because you are always mending your ways. (Laughter.) Perhaps if some of the rest of us did it we would get some applause at times from the great public, but we are so busy watching your ways that sometimes we haven't time to mend our own.

Now, a writer that we all admire has said that he is the truest cosmopolite who loves his native land the best, and you will pardon me if I devote most of my time to-night to the land from which I come. I believe you expect that of me, and I might say, sir, that the only remark I have to make with surety is that I am not at all able to do justice to the subject. If we were to compare the size of the two countries, the United States and Canada, there is little to choose between them. You are older than we are and you have a larger family. Your entire homestead is now pretty nearly occupied by your family. You have 80,000,000 people; we have 8,000,000 scattered over about an equal territory. You have approximately, or nearly so, reached the limit of your arable land; we are just on the verge of tickling the edges of our great productive soil; and we have what I might call the last great West.

Last year was, I might say, almost a record year in its productiveness. We have in the West about 212,000,000 acres of arable land in the three provinces, Alberta, Saskatchewan and Manitoba; and out of that 212,000,000 only 12,000,000 yet are under cultivation, or less than 6 per cent. Last year they produced 364,000,000 bushels of wheat, barley and oats, or, if we take Canada all together, without going into details, per acre of the land tilled we produced 24 bushels of winter wheat and 21 bushels per acre of spring wheat—a record per acre equaled by a few older countries, but by no country on this continent.

The productiveness of Canada, of course, means something to you as well as to us. We cannot live side by side, the United States and Canada, without each reflecting on the other. If we are sane in our commercial relations, your success must mean our success; and if we are successful it must in a measure reflect that success upon your business. Now, sir, that great increase in productiveness of course means an increase in railway traffic and in transportation by our great waterways. It might be interesting, Mr. President, to railway men to know that in Canada our freight has the longest haul, averaging 197 miles—which may be a joy or a sorrow to railway men, just as you look at it and according to the grades you climb.

In addition to our productiveness, of course, in the great West, we have the remainder of Canada. We have our industries, our fisheries, our lumber, our pulp wood and our minerals. It would not be out of place, I think, Mr. President, if I would say, not egotistically, that I think we have in Canada one of the greatest sources of wealth of any country in the world in our fisheries. We have great resources in our timber, in our pulp wood, which I am inclined to think you will want to utilize in the years to come, as you have utilized it in the years gone by.

In the province of Ontario, I think we have the greatest nickel mine in the world. As you all know, Canada and a certain French colony control the production of the world's nickel, and in this age, when so much nickel is being used, and more is to be used in structural work, in ship building and kindred industries, you will agree with me that to have the source of supply for this great commodity is no small thing for a young country like Canada.

Now, sir, we are growing, as I stated before. Our trade this year will be something like $650,000,000, and 47 per cent. of that trade is with the United States, rather proving, as I have pointed out, that it is to the interest of both countries that we should be sane, so far as we can be sane, in the matter of our trade relations one with the other. But there is this point that strikes me—you will bear with me for pointing it out to you—that while you have eighty millions of people, you only bought half as much goods from us as our eight millions bought from you. Now, perhaps we were better able to buy than you were. The fact remains that while you sold us $180,000,000 worth of goods, we sold you some $90,000,000 worth of goods. Again, it brings me back to the point that we are each interested in the other. Now, I must not get on dangerous ground, or, as I might call it, thin ice. I am not here to make any political suggestion from a party sense at all. But naturally in discussing these trade relations the question of what keeps us from trading or what would induce us to trade forces itself on one's mind. You have some things evidently that we want to buy or we wouldn't have bought them—twice as many things as you bought from us—and if we make it impossible for you to sell to us, it will hurt somebody, and whichever way you look at it, you can form the decision from that point of view, whether it hurts the one that is selling or the one that is buying. That is a question of political economy that I dare not discuss.

You have passed a statute, which has received the approval of your president, which enables you on a certain day, a few days hence, to bring into force what is called the maximum-minimum tariff. The maximum tariff will apply to everybody who is not excused and placed on the minimum tariff. We have on our statute books a provision enabling us to put into force what is called a sur-tax, which is really a maximum tariff, or an addition to our regular tariff. That sur-tax was placed upon German goods for several years and only removed a few weeks ago.

Now, speaking for myself, but quite plainly, I think there is no reason under the sun why these two countries, living side by side, should enter upon a tariff war. (Great applause.) We both have clubs to use in our statutes, but I see no reason, I see no tangible excuse, why either of us should

produce the club. Now, sir, I feel that I should not say a word more on that point.

Returning to the Canadian point of view, I want to point out that we have great potentialities for growth. During the last ten years there have come into the Dominion of Canada something like 1,500,000 souls. During that time, I am happy to say, there have come from the United States into Canada something like 500,000 souls. They did not come without bringing something with them. They are not only able to hew out homes for themselves, but they have brought some capital with them, and it is estimated that these people from your country coming into ours brought fully $400,000,000 with them in cash and household effects. Now, $400,000,000 coming from the United States to Canada is more than all our national debt, so you see that during the last ten years you have given us enough to wipe out all the debt we have in Canada and have enabled us to put quite a surplus in the treasury. (Applause.) For this, sir, I will ask you to join me in thanking the United States.

We are glad to have your people come and take up their abode with us, and you need not at all, sir, have any fear that any stock is taken in certain scare-head despatches you occasionally see that there is any fear in our country that these settlers will not make first-class citizens of the Dominion and first-class Canucks. You say, that was during the last ten years, but what about the present time? I might say that during the last ten months we have had 81,000 of your fellow countrymen come over to be fellow countrymen of mine. They look good to us. (Laughter and applause.) And, sir, I want to say again, that we are delighted to have them with us, and particularly are we delighted because 43 per cent. of these men take up homesteads in our great Northwest and are today assisting in producing goods that somebody will have to build railways to carry out of the country.

Now, sir, we have great potentialities for growth in other directions, but the ones I have mentioned are perhaps the most interesting to you. In Canada we have taken upon ourselves great burdens in the matter of transportation and in other matters as well. There is a different system prevailing in Canada in respect to the initiation of a railway project from what exists in this country. You in your country, I think, in the main, do not have to go to Congress for an act or statute to enable you to be incorporated to construct a railway. In our country a charter has to be procured, and we have to place on the statute book that charter with its various provisions, before those wishing to undertake that work can do so.

I often come in contact with the great body of intelligent engineers in relation to these matters, because it devolves upon me, Mr. President, when the capitalists intend to build a railway, to help them locate the railway, to help them make up their minds where they will put it, not where they would like to put it, but where they will put it. (Laughter and applause.) In a new country everybody is anxious for the railway line to come as nearly as possible his way, and it is not an easy task to approximately please the population who are trying to get this railway communication, and are crying out for it, without having the railway companies harbor feelings of discontent. Sometimes they are more enthusiastic than that. (Laughter.) My position in that regard is not a bed of roses, but notwithstanding my Scotch name, I am Irish, and a bit of a scrap does not hurt me in the least. (Applause.)

When a charter is applied for and granted, and the location is about to be made, the railway company applies to the Department of Railways and files its location plans. These have to be approved by the head of the Department of Railways and Canals, and our Board of Railway Commissioners can not vary that location one mile either way, after it is approved by the minister. It is an advantage that the people are invariably consulted as to where the line will go, and although they are not always pleased, it gives pretty general satisfaction to them to know that a responsible minister has it in his hands to locate the line of railway or to approximately do so, because in our country they can get at a member of the Government very quickly. He sits in the House of Commons. The members of your cabinet do not have a place in Congress, and are not subject to the heart-to-heart talks and the face-to-face exhortations that we are. (Laughter and applause.)

We feel it our duty, so far as the finances will permit, to give the people we bring into our country the fullest opportunity to get value for the labor they put upon the soil introducing their crops, and in order to get that value the price of transportation must be reduced to a minimum, because the nearer you can get the consumer and producer together the greater will be the revenue that comes to the man that produces the goods.

Now, sir, in the Dominion of Canada we have been more than liberal in our aid of the railways. Out of the federal treasury alone we have given $135,549,000. The provinces, corresponding to your states, have given $35,500,000. The municipalities have given about $18,000,000. The government of Canada owns railways itself and operates them, which have cost $111,000,000. They are now building another line which will cost approximately $125,000,000. All told, there has come directly out of the people for railway transportation in Canada $425,500,000. But that is not all, sir. In addition to that, in years gone by, when land was not as valuable as it is now, large grants of land were given to the railways, to the C. P. R., among others, and the balance of these railways were guaranteed by the government of the Dominion and the governments of the provinces.

All told, I think the people of Canada, who now number possibly 8 millions or 7½ millions, have given directly for transportation, $750,000,000, or about $100 for every man, woman and child in the Dominion of Canada. In addition to that, of course, is the private capital invested, about one billion and a half, in railways. In our maintenance of way last year in the Dominion of Canada, the railways spent 20.2 per cent. of their operating expenses—I thought I would say that to you so you would let me know quietly, some of you, if that was the proper proportion or not. (Laughter.)

Some four or five years ago the government conceived the idea that we ought to have another transcontinental line, and immediately they proceeded to arrange for its construction. The Grand Trunk Pacific line will be approximately 3,600 miles; 1,804 miles of this line, from New Brunswick to Manitoba, are being constructed by the govvernment. The Western branch, to the Pacific coast, is being constructed by the Grand Trunk Pacific Railway itself. When these two divisions are completed the Government will lease to the Grand Trunk Pacific for fifty years the Eastern division for its operation, so that we will have in that line a government-owned and company-operated line; on the other half, a company-owned and government-operated line. But as you have in the United States, so we have in Canada a body that thoroughly regulates all the railway companies to see that they do not charge exorbitant rates. I am sure you are enthusiastic over that. (Laughter.) Now, sir, we are told, and you are told, that that line is going to cost a lot of money, particularly the Eastern division. I would not dare say a word about the cost of the Western division. It will be large, I suppose as it ought to be, but the

Eastern division being a government-constructed line, comes under peculiar and particular criticism. As against east-bound traffic, which will be the greater amount of traffic, we will have a grade of 0.4 of 1 per cent., except in one or two places where pusher grades will be used, while against west-bound traffic the grade has been obtained of 0.6 of 1 per cent.—almost a level line.

Then we have another line in the Dominion of Canada —and who has not heard of McKenzie and Mann?—they have been constructing lines in different parts of the Dominion, east and west.

Now, as to the great waterways of the Dominion of Canada and the United States in common—this perhaps has not impressed itself upon you, who are along the Great Lakes in this section—but Canada owns the gateway of the St. Lawrence.

Then, sir, we have our great canals. You have your canals; we have nineteen. We are going to have more in a few years. I will not at all discuss with you the advisability of enlarging the Welland canal; that is one of the things that will be done in a few years, so that the five hundred and more great lake vessels that now have to stop at Port Colburne and unload will be able to go through the Welland canal down at least through the lakes to the head of what is known as the St. Lawrence canal. When the Welland canal is deepened, wheat can be carried from Duluth to Montreal, forwarders tell me, at a fair profit at three and a half or three and five-eighths cents per bushel. What is known as the Georgian Bay canal project is now before the people not only of Canada, but of all the world. That canal, of course, would connect the Georgian Bay at Lake Huron with Montreal, where there is a deep ship channel going out to sea. It would save a good many miles even over the Welland canal and the Great Lakes route.

The government is beginning this year to start the construction of the Hudson Bay Railway; that is, a railway from the center of the wheat belt of our great West to Hudson Bay. It will not only afford a splendid means of transportation for the grain products, but it will give an advantageous route for the stock of the great western lands to be carried to the markets of the old country with a very short railway haul and a cool route as long as navigation is open, which is a great advantage in the transportation of stock.

Now, as to the Quebec Bridge project. The Anglo-Saxon race never knows defeat; what they undertake they generally accomplish; and the government of Canada has taken over that project from the Quebec Bridge Company and has placed it in the Department of Railways and Canals. When the government took over this project, I suggested—and they adopted it—the formation of a board of engineers, prominent bridge engineers, to whom would be given full authority to make the plans, and to see that the bridge was constructed under the plans, so that if there as failure we would know where the failure ought to be placed. Mr. Fitz Maurice, the chief engineer of the County Council of London, England; Mr. Votely, of Montreal, and last, but by no means the least efficient and able member of that board, is Mr. Modjeska, of the city of Chicago. (Applause.) The span of this bridge will be nearly 800 feet; the width, 88 feet; and it is designed to carry two double steam railway tracks, two electric lines, two roadways, as well as accommodations for foot passengers. You are engaged in a great work; so are we. Our relations are most cordial; they ought to always be. If you will allow me in the words of a very crude couplet, which some of you may recognize, though slightly modified, I will express the feelings we have in Canada towards you:

Dear Samuel, we like you; yes, we do;
  We are proud of your gentile touch;
But we cannot leave Mother, not even for you;
  She is so kind and we love her too much."

(Applause.)

Ralph M. Shaw.

Mr. Toastmaster and Gentlemen: The ordinary railway man at present is in very much the same mental condition as was Swanson after the accident to Oleson. Upon being placed on the witness stand he was asked:

"Gus, did you see the accident to Oleson?"

A. "Yah."

Q. "Well, tell us about it."

A. "Well, me and Ole we was walking along the track and Aye heard the engine coming, and when it passed by Aye stepped on again, but Aye don't see nothing of Ole, and by and by Aye tank Aye see Ole's hand, and by and by Aye tank Aye see Ole's leg, and then Aye tank Aye see Ole's hat, and then Aye tank Aye see Ole's head, and Aye say to myself, 'By goll, Aye tank something must have happened to Ole.'"

The very name—the American Railway Engineering and Maintenance of Way Association—implies a picked body of men. You it is who have conquered the morasses, bridged the rivers, tunnelled or scaled the mountains, and by economies in construction and operation have, regardless of advancing wages and increased operating expenses, made it possible for the companies in recent years to maintain a balance upon the right side of the ledger.

The Constitution says that Congress shall have the power "to regulate commerce among the several states." In my judgment the framers of the Constitution had no purpose in view in conferring upon the Federal government the power to regulate commerce among the several states, other than that they could thereby prevent the various states from imposing restrictions upon the free interchange between themselves of their agricultural, mining and manufacturing products. If at that time Congress had attempted to determine, by law, the details of the construction of a stage-coach plying between New York and Philadelphia; or to fix the rules of liability as between master and servant in cases of accident; or the number of hours which the coachman might drive, it would not have been tolerated for a moment, but would have been denounced and repudiated as an unwarrantable interference by the legislature with the rights and privileges of a free people. (Great applause.)

Forty years later, the state of New York attempted to confer upon Robert Livingston and Robert Fulton the exclusive right to navigate upon all of the waters within the borders of that state. That grant of power was attacked by owners of vessels coming from points outside of the state and destined to points on the island waters of the state, and the interpretation of the phrase "to regulate commerce among the several states" came before the United States Supreme Court. In interpreting the phrase, Judge Marshall said:

"Commerce, in its simplest signification, means an exchange of goods; but in the advancement of society, labor, transportation, intelligence, care and various mediums of exchange, become commodities and enter into commerce; the subject, the vehicle, the agent, and their various operations become the base of commercial regulation." No definition has since been given which is so compact, so complete and so far-reaching. This power was never attempted to be exercised by the government until 1887, when the federal government, for the purpose of eliminating abuses arising the great development of the country, passed the original Interstate Commerce Act, ordinarily known as the Cullom Act.

Congress or one of its administrative bodies now regulates many of the most important incidents of ownership which formerly belonged to the companies. They have left to them only the shell, the right to operate, and the right for which they are in a great measure indebted to the Supreme Court of the United States, to make a modest return on the millions invested.

It is claimed by eminent men, such as President Hadley of

Yale University and ex-President Roosevelt, that if a correct valuation of the railroads was now to be made, that the outstanding capitalization of all the railroads of the United States, at par, would not exceed their present physical value. Upon this valuation they are not now earning to exceed four per cent.; the owners of capital invested are dominated by a power which exercises these incidents of ownership and has none of its responsibilities.

We search the statute books and laws of Congress in vain for a single federal enactment which has been devised and passed for the benefit of the railway companies. For the farmers who may buy land, work it and sell it as they please and charge such prices as they can get; for the manufacturers who may earn unlimited sums upon the capital invested, the Congress of the United States has passed a protective tariff. For the railways it has enacted laws which tend to diminish profits.

The railways themselves are heavy buyers of manufactured commodities. As was stated by Samuel O. Dunn in an article published in August, 1909, if there was no tariff in this country, foreign rails could easily be shipped here and sold for $22 to $25 a ton, and the United States Steel Corporation could easily meet this price; for the cost of making rails in this country is lower, as Andrew Carnegie has said, than anywhere else in the world. But there is a tariff per ton, which enables the domestic manufacturers to charge American railroads $28 per ton. Suppose now that the railways, in order to recoup themselves for the high price that they pay for rails, should advance their rates on iron and steel; there is not much doubt, in view of the Interstate Commerce Commission's decisions in many similar cases, that this raise in freight rates would be held unreasonable and illegal. (Applause.)

These considerations, however, though of moment, are of but small importance in comparison with one great defect in the present relations between the government and the railways. I refer to the safety-appliance and hours-of-labor legislation.

While for the purpose of complying with the laws, millions have been spent and are being spent by the companies for improvements in equipment, etc., not one law has ever been passed by the federal government aimed at fixing individual responsibility for accidents. In Mexico, at whose laws and civilization we sometimes sneer, when an employe of a railway company, through his negligence, is responsible for an accident resulting in damage either to person or property, he is punished promptly by the state. There are similar laws in England and Canada.

During the past few years one of the great systems in this country has spent more than five million dollars in installing along the entire line of its road the most modern safety and signal appliances which human science has yet been able to devise. Within a year four bad wrecks have occurred on the line of this road, resulting in enormous loss of life and property, caused by the neglect of the train crews to recognize and follow rules and regulations established for their safety, and which, if observed, would have prevented the accidents. There is no law under which they may be punished. The railway is responsible for the accident and must pocket the loss and pay the damages.

Under the Federal Safety Appliance Act it is not made a crime for an employee to couple up a defective car into a train, but it is made a crime for the company, who has no knowledge of the defect, to haul the car so coupled up, and use it for transportation purposes. The employees of the company are urged to report violations of the law to the employees of the government. In other words, the men who make the company violate the law, by refusing to report defective cars, or by coupling them into trains with knowledge of their defects, are encouraged by the government to report violations so made against the companies, who are substantially helpless in the matter.

No greater injury could be done to the confidence and good-fellowship which ought to obtain between the companies and their employees than to create and promote such a system of espionage, by which those who violate the law and are by the law held blameless, become the witnesses in criminal cases against the companies, who are not responsible, morally, for the violation. It destroys discipline and creates hostility. It is an evil which, in justice to those who have the responsibility, but not the power, should be rectified by the government, which has the power and not the responsibility. (Applause.)

Dr. Harry Pratt Judson.

We are fortunate in this country not to have much of a leisure class. Men who are brought up with an ample income and with no particular necessity for work, may or may not be useful members of a community. In some countries, no doubt, some of them have been valuable in public service and also in their devotion to literature and science, but the tendency invariably in such cases is to create a body of men whose chief occupation in life is amusement, and they are of no particular value to the community at large, and, I fancy, of not much value to themselves. In this country, thus far, the necessity of work is pressed hard in everybody, and therefore we have a generation of active workers, with a knowledge of multifarious affairs of business and professional endeavor. Our colleges, therefore, are not places of elegant leisure, but places designed to train young men for active life in some shape, and the first duty of the college is obedience to the fundamental life of our most modern society, and that is to the life of service.

No one is really entitled to a place in our social organism unless the sum total of his efforts is a benefit to the community. In short, in whatever line of life he engages he should render a distinct and valuable service to his fellows in order to be entitled to rewards which normally should follow from industry. This is true of manufacture, and of commerce most distinctly. It is true of various learned professions. It is undeniably true of those engaged in the great activities of transportation. Modern society in all parts of the world and in all its developments rests fundamentally upon the means of transmitting intelligence and transporting persons and commodities from place to place. If the modern means of accomplishing these needs should be materially crippled, our most industrial cities would be paralyzed. On the other hand, with the advance of industry, improved methods are applied also to transportation. Thus these lines of transportation are arteries of social life. They carry the blood into all parts of the social organism.

As young men grow up they should be afforded by the community facilities for preparation. These facilities should run to the particular lines of life which it is likely they will follow. Roughly speaking, you may divide education then into two groups, which we will call for convenience the lower and the higher. Lower education affords the general basis of intelligence which should prepare for good citizenship and which should enable one in some lines of labor to earn an honest living. The higher education affords that basis of intelligence and aptitude which trains one for activities resting on a large basis of expert knowledge. This is true of the life of engineering and medicine. All these can be prosecuted successfully only by one who is master of a considerable body of scientific knowledge. This body of knowledge it is the function of institutions of higher learning to provide.

At the same time these professions require not merely a basis of knowledge in these sciences, but also expertness in the application of this knowledge. These applications are continually changing. New methods are being devised all

the time. One who is thoroughly versed in the methods of today may be entirely at sea in a year or two, unless he keeps pace in advance of knowledge. Therefore, for the proper training of young engineers, there is needed not merely fundamental schooling, to which reference has been made, but also constant practice of the applications of schooling to practical conditions. Engineering schools, of course, attempt to do this, but in all schools of this kind, which have come to my knowledge, there is the grave difficulty that this training tends constantly to lag behind the progress of the profession. I have been told by the head of an engineering school that when expensive machinery is installed, very soon it is found that this machinery is already far behind the times. Young men who are trained in its use are of little value.

It seems to me that a solution may be found for this difficulty if a combination can be effected between the school on the one hand and the profession on the other, so that the student in constant touch with the actual application of what he is learning. In some branches of mechanical work, for instance, the matter has been solved in this way: Students are arranged in groups of two, one being always in the school and the other always in active work. In one school, for instance, the student has two weeks in school and then two weeks in the shop. Of course, in other branches of activity the time may be readily changed, the student remaining two, three, or four months in school, then taking a similar time in active employment. If this can be carried out in engineering as effectively as it has been in some branches of mechanical art, it would seem that the student might benefit from the practical experience which he should acquire, accompanying his theoretical thaining, and the profession he might gain from supplies of intelligence and assistance. In the long run I believe that the product of such combined training would reinforce the profession by a body of better trained and more practical men.

Certainly all of the colleges have the means to advance this profession, a service for which they exist under the general law of service, and it is the duty of every college to render an immediate benefit to the welfare of the community in which it is placed.

The purpose of the university in its largest sense is somewhat different. The essential university idea is that of investigation and discovery of new knowledge. It is the belief of many thoughtful engineers that there is a field for research in engineering, which would be of great value to the profession. If the university should undertake this line of activity, it would involve investment of considerable funds and of constant employment of a number of experienced and successful engineers in pursuing these specific investigations. This to the university is an interesting subject for inquiry, and it seems likely that the time is not far distant when the university should be able to render this important service to professional engineering.

Hon. Milton J. Foreman, Member City Council of Chicago.

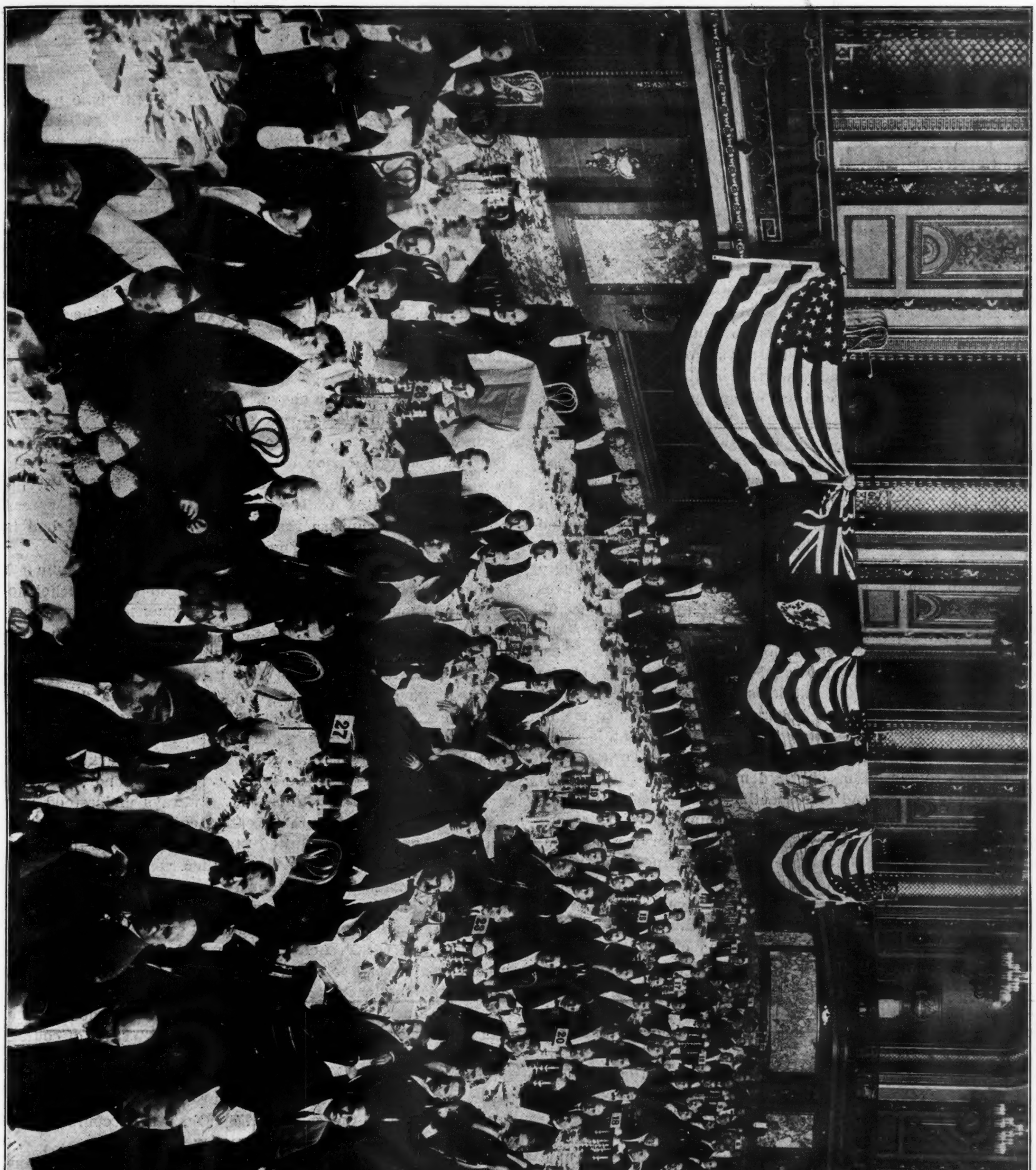
Mr. President, ladies and gentlemen of the association with an unspeakable name: I feel that I have a peculiar right to talk here tonight, because for eleven years I have been advising the managers of the railways in this city how to run their roads, and for eleven years they have studiously and steadfastly violated my advice and ignored it. (Laughter and applause.) I do not retract a word, even though my advice has been found wanting. It is natural that there should be on the part of railway men some impatience at the legislative operation of railways. Men in the legislative bodies cannot understand that. Railway men can.

If I were to talk about the relation of legislative bodies to railways, I would say that the relation is that of a mother-in-law, a kind and gentle mother-in-law, but one who is not sparing in her admonitions.

Now, we, in Chicago, had some experience with railway engineers. We have discovered that they are a hardy race; their patience and faith outruns their work, so far as the city of Chicago is concerned. We have a faint, glimmering idea that some time we would like to have locomotives quit smoking—just a diaphanous day dream, gentlemen, born in the solitude of our legislative chamber. We consult the railway officials, and they say, "Certainly; perfectly feasible, and we will refer it to our engineers, to show you how absolutely impossible it is." (Laughter and applause.) If the engineering department of a railway is good for nothing else, it is good to show the utter futility of cities attempting to do anything they think they would like to do. They do not shock us, by telling us, brutally, that we cannot do it; they accommodatingly show us a series of blue prints, with wavy lines, and after we have seen these blue prints, series and tomes, and volumes and editions, they tell us it is absolutely certain now, that it can be done, but "we have got to get out another set of blue prints to show you how impossible it is." (Laughter and applause.) I applaud their patience and ingenuity. Of course, I do not think that everything is true that is said about them.

I was at a funeral once and the pastor delivered a very glowing tribute to the dead man, and while he was talking a distinguished lawyer of Chicago, who is now dead—I say that to differentiate him from Shaw—walked over and looked into the coffin very intently, and tiptoed back to a corner of the room, and after the funeral services were over the minister said, "My friend, why did you look at the corpse?" The lawyer replied: "In listening to what you had to say, I came to the conclusion that I was at the wrong funeral." (Laughter and applause.) So I am willing to justify the lack of works on the part of the railway engineer, so far as Chicago is concerned, in view of the tremendous faith and energy they show in giving us illustrations of what ought to be; not that Chicago is without engineers of its own. Now, the railway problem, so far as Chicago is concerned, and I speak of Chicago particularly, is an engineering problem. We leave to nations the matter of the regulation of rates, and to states the regulation of the safety of passengers, and to nations, too, and to states, also, the proper regulation of railroad lawyers, but ours is an engineering question. It is a question of track, stations, elevation, switches, frogs and that sort of thing, and it is upon you that we depend for the proper solution of these things, not that we have not got engineers in Chicago, not that we have not got engineers in the City Hall—we have tried engineers there. (Laughter and applause.)

We have even got some against whom charges have not yet been filed. But it is a particularly special piece of work and the city of Chicago is very much indebted to the railway engineers for what has been done. No city presents as many physical difficulties as Chicago. It is idle for the people to say the railroads owe us a duty. Chicago and the railways are tied together. They are as necessary to one another as much as it is possible for two things to be dependent upon one another. They cannot get along without one another. Chicago's life has been a life brought to it by railways. The railways are getting their life from Chicago. Chicago is a trading post. They may call use an overgrown village, but it is a great trading and manufacturing place, but requires railways. But that does not excuse the railways from doing their duty. I know they have hard luck. I have listened to Brother Shaw. They have almost as hard luck as a chap who owed a friend of mine money and he used to pay him



Annual Dinner, Maintenance of Way Association.

interest every year by check. He finally got so hard up he couldn't pay interest any more, and he finally sent the interest money by money order. He said, "I went on to the Stock Exchange, and it broke me. I have had such hard luck that if the good Lord said, 'Come forth, Lazarus,' I would come fifth." (Laughter). So you see, I am not without sympathy for the railways. Much has been said about repressive and regulating legislation. Much legislation is unnecessary. Perhaps some is necessary. But no public service corporation that reflects and responds to the just requirements of the public need have fear of oppression or interference. The people are quick to recognize when they are justly treated. I recognize the fact, and I agree that in the first years of railroading and up to the present time there has been much uncertainty, much guess work, and occasionally there has been some sandbagging. There is no doubt about that; but let the municipalities and the railways work hand in hand; let the railways grant and give these things to the people that the people are justly entitled to, no legislative body dare, no legislative body will impose restrictions, regulations or oppressions on railways or on any other public service corporation. We have had experience in Chicago for years. It was the open season on quasi-public corporations. It was a mighty poor alderman that couldn't take a shot at a street railway company every morning. We have well defined ordinances and well defined laws. Five years more will find the entire public service question in Chicago settled. There will be well defined principles, and well defined ordinances for street railway companies, electric light and telegraph companies, and they will be out of politics and out of the legislative hall. (Applause). I don't blame the corporations, particularly railway corporations, for not wanting to be governed by city councils and legislatures. I have been at Springfield myself as an on-looker, and I recognize some of the irrational laws represented by miners, but that is often due to the unwillingness of the public service corporations to recognize the trend of public demands, public needs and public rights, and instead of respecting public needs, the public rights and public demands, they wait until they are forced upon them. Instead of controlling the public service question, they permit it to be controlled by men for personal needs or personal gains. There is as much political wisdom in the railway business as there is in any legislative hall. There is no reason why the public service policy of this country should not run hand in hand with the operation of public corporations serving the public. If the public service corporations, moved by an enlightened selfishness, will recognize the public tendency of things and grasp the opportunity to work out these problems with proper public officials and the proper public organizations, we will have no trouble with sandbagging of the public corporations. The public will suporpt the move, no matter from whom it comes, and if not, it will be because the public service corporations have left the field to either the reformer so-called, or to the man who uses public service corporations for his own purposes or aims. I do not mean that the public service corporations should go into politics, but I do mean the result of their service can make harmless any oppression or sandbagging tactics. The transportation problem in Chicago, the smoke problem, and the station problem will be solved by the city of Chicago and it has been taken out of the city council for all time. There is a close bondship between a city and its railways. Where one profits the other profits, where one loses the other loses. Public service corporations operating without profit operate at the expense of service. A profitless public service corporation is a drag and a detriment to the city, to the state and to the country, and railway corporations and every corporation must recognize the fact that they stand in a different relation to the people than any other form of industry; that they bear a practical duty, and when they fulfill their duty they need have no fear that there mother-in-law will give them the bed-slat. (Laughter and applause).

A. H. Rudd.

Mr. Toastmaster and Gentlemen, and You to whom we look up as a benediction that makes our lives worth living, it seems almost a crime to introduce such a disturbing element as a signal man, and I notice that even the thought of it has begun to thin out the audience. The evening probably has passed very quickly with you, but I feel like the gentleman Mr. Foreman told about, Lazarus. I have come fifth. And I have been reminded of the story of the poor fellow at the hospital who was lying in a sick bed for a long time, and finally one day he decided he would like to see what he looked like, so he reached over on the table at the head of the bed and picked up, instead of the mirror, a hair brush. He gazed into it a few minutes and said, "Gee, I need a shave." (Laughter.) I feel if I had waited here about five minutes, I would need a shave.

In figuring out why I was asked to speak to you I was reminded of the story of the farmer who set a poor, puny, little bantam chicken on an ostrich egg, and somebody said to him, "What in the world did you do that for?" "Well," he said, "I wanted to see the durned little thing spread itself." Now, I suppose that is what the gentleman had in mind when he requested me to address you.

When I listened to the eloquence of the Hon. John W. Lawson last year, and when I listened to the speeches tonight and thought of my own lack of eloquence, my own lack of information, I felt like the old minister who used to draw a comparison between his insufficiency and others'.sufficiency, and he used to say, "When God made a whale He made a minnow; when He made an elephant he made a flea; when He made me He made a daisy." After hearing Mr. Ross and Mr. Graham, after coming in pleasant contact with such notable men last year, and with other honored members from Canada, especially those we have particularly honored—where is Kelley? and Mr. McNab?—I have always understood why it was that Canada was the greatest country on the western continent—north of the United States. But I don't think that we ought really to forget some other members of Canada who have contributed tremendously to make that country what it is. A friend of mine who was in Canada last year met a most enthusiastic French Canadian and got discussing Laurier with him, and the French Canadian said, "Laurier, he ees ze greatest man ever live." "Well, now," my friend said, "how is he the greatest? there is Washington." "Yes, of course, dere ees Washington; he vas president; but he ees not so great man as Laurier." "Well, there is Napoleon?" "Oh, of course, Napoleon, he great general, but he not so great a man like Laurier." "Well, there is the Czar?" "Yes, he great emperor, but not so great a man ees Laurier." In desperation my friend said, "Well there is God?" "Oh, yes, of course, there is God; but Laurier he a young man yet."

I came, gentlemen, from Philadelphia, the land of gastronomy, the home of catfish and waffles, the resting place of scrapple. I felt like it to-night. We have been taught—were taught there—that the foot that rocks the cradle rules the world. We found out lately that the man that rocks the trolley car rules the city. In Philadelphia, they say in New York. they don't eat snails; not because they are very cannabalistic, but because they can't catch them. We have been going some there lately. We have developed a new declaration of Independence. The Independence of the Sons of Martha is my toast, from the contractual obligations to their employers, as evidenced by the general sympathetic strike. Now, there is a chance for a whole lot of talk, a whole lot of eloquence, but I am not going to attempt it, because I am in the same fix as the old lady from Ireland was when her neighbor accused her dog of having bit her boy Patsy and she denied it.

Her neighbor was also from Ireland, and the dispute ran in this fashion: "Your dog bit my boy Patsy last night." "He did not." "He did." "He did not." "He did." "He did not, for three reasons: In the first place, my dog is too old to bite your boy Patsy; in the second place, he has no teeth to bite your boy Patsy with; and in the third place, I haven't any dog in the first place." And that is the truth of my eloquence.

The Sons of Martha is a generic term, I understand, for those who labor with their hands as well as their brains.

Aside from the laborers, there is another class of the Sons of Martha, the young engineer, and he was asked how he would obtain the height of a house by means of a barometer, and he said he would tie it to a string and lower it to the street and draw it up again.

In closing, before we adjourn to the palm room, I suppose, I want to read a rather old poem. I am sorry I must read it, but when I was seven years old, under the tutelage of my honored grandparents, I committed to memory that grand old hymn "Barbara Fritchie." While this poem is, I believe, intended to cover the Sons of Martha that labor with their hands, a poem by Rudyard Kipling, I think it refers particularly to the engineers as we know them, and is especially applicable to our work in all its branches. There is an uplift and inspiration for those who love our profession, that it is well worth keeping before you.

The Sons of Mary seldom bother, for they have inherited that good part,
But the Sons of Martha favor their mother of the careful soul and the troubled heart;
And because she lost her temper once, and because she was rude to the Lord, her guest,
Her Sons must wait upon Mary's Sons—world without end, reprieve or rest.

It is their care in all the ages to take the buffet and cushion the shock;
It is their care that the gear engages; it is their care that the switches lock;
It is their care that the wheels run truly; it is their care to embark and entrain,
Tally, transport, and deliver duly the Sons of Mary by land and main.

They say to the mountains, "Be ye removed!" They say to the lesser floods, "Run dry!"
Under their rods are the rocks reproved—they are not afraid of that which is high.
Then do the hilltops shake to the summit; then is the bed of the deep laid bare,
That the Sons of Mary may overcome it, pleasantly sleeping and unaware.

They finger Death at their glove's end when they piece and repiece the living wires.
He rears against the gates they tend; they feed him hungry behind their fires.
Early at dawn ere men see clear they stumble into his terrible stall,
And hale him forth like a haltered steer, and goad and turn him till evenfall.

To these from birth is relief forbidden; from these till death is relief afar—
They are concerned with matters hidden—under the earth line their altars are.
The secret fountains to follow up, waters withdrawn to restore to the mouth—
Yea, and gather the floods as in a cup and pour them again at a city's drouth.

They do not preach that their God will rouse them a little before the nuts work loose;
They do not teach that His pity allows them to leave their work whenever they choose.
As in the thronged and the lightened ways, so in the dark and the desert they stand,
Weary and watchful all their days, that their brethren's days may be long in the land.

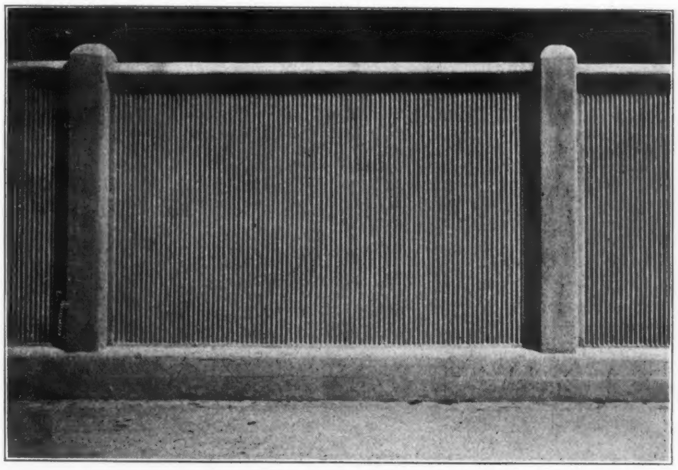
Lift ye the stone, or cleave the wood, to make a path more fair or flat—
Lo! it is black already with blood some Sons of Martha spilled for that.
Not as a ladder from Earth to Heaven, not as an altar to any creed,
But simple service, simply given to his own kind, in their common need.

And the Sons of Mary smile and are blessed—they know the angels are on their side.
They know in them is the Grace confessed, and for them are the Mercies multiplied.
They sit at the Feet, and they hear The Word—they know how truly the Promise runs.
They have cast their burden upon the Lord, and—the Lord he lays it on Martha's Sons.

REINFORCED CONCRETE FENCE FOR THE LONG ISLAND.

BY J. P. H. PERRY.

Although concrete has become very popular during the last few years and has been adopted in many forms of construction, its use for building fence is comparatively new. The Long Island Railroad, in connection with a very large improvement at Flatbush and Atlantic avenues, Brooklyn, N. Y., consisting of a terminal station, subway and depressed freight yards, built nearly two miles of reinforced concrete fence, which is exceptionally pleasing in appearance and decidedly satisfactory from an engineer's point of view. A section of the completed fence is shown in one of the illustrations herewith.



Section of Finished Fence.

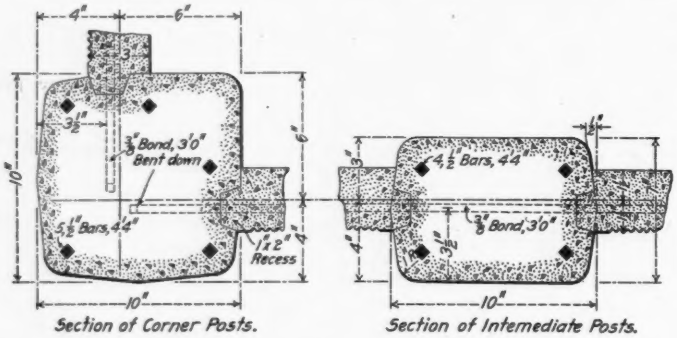
The considerations leading to the choice of concrete for fence construction by the engineers of the railway are as interesting as the structure itself. The Atlantic avenue terminal yards, which this fence encloses, is almost exclusively of concrete. Not only are the retaining walls of this material, but the stairs, platforms, bridges, floors and roofs are of concrete. It was therefore logical to make the enclosure of the same character of construction. More important in the discussion of the different types of fence

possible of selection was the necessity of having one through which the general public could not see. Wood was eliminated as being not alone only temporary in character, but unsightly and not in keeping with the monumental nature of other structures. The usual designs of pipe railings, pickets or parapet received little consideration. The style chosen avoided all the disadvantages of the more common forms of fences. The only serious objection to concrete was the use to which small boys frequently put it. Smooth concrete surfaces are often defaced by being marked upon. This condition was overcome by corrugating the street side surface of the fence. Some parts of the Atlantic avenue fence have now been standing for nearly two years and are so far unscarred.

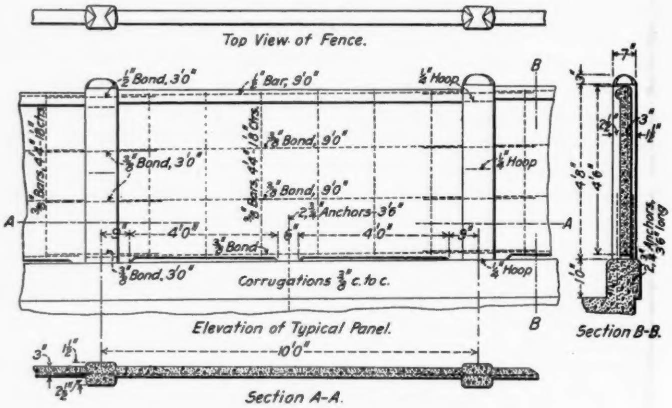
The details of the design of these fences are shown in the line cut. The panels are generally 3 in. thick and 9 ft. long. They vary in height from 4 ft. 8 in. to 6 ft. The reinforcement consists of ⅜-in. cold twisted steel bars, spaced 20 in. on centers, horizontally and vertically. The posts between the panels are reinforced with four ½-in. bars and are provided with horizontal bond bars as indicated.

In building these fences, two methods were employed. At first the panels were cast in a horizontal position, and after the concrete had set sufficiently to permit safe handling, were placed on the coping of the retaining wall. By this method, the sections butted against each other and were held in place by knee braces, and the posts did not come between the panels. The more successful scheme consisted of casting the posts in position, after which the forms for the panels were set up and filled, alternate panels being concreted. This latter method is shown in the half-tone illustration herewith.

The corrugated surface on the street side of the fence was obtained by fastening a sheet of corrugated iron to the inner face of the form. In good weather, the forms for the panels could be removed in about 12 hours and used again in the next section. After a considerable portion of the fence had been concreted, white sand and La Farge cement, in a 1—2 mixture, was applied with a brush. This produced a uniform color and gave a whiter surface than would the plain concrete.

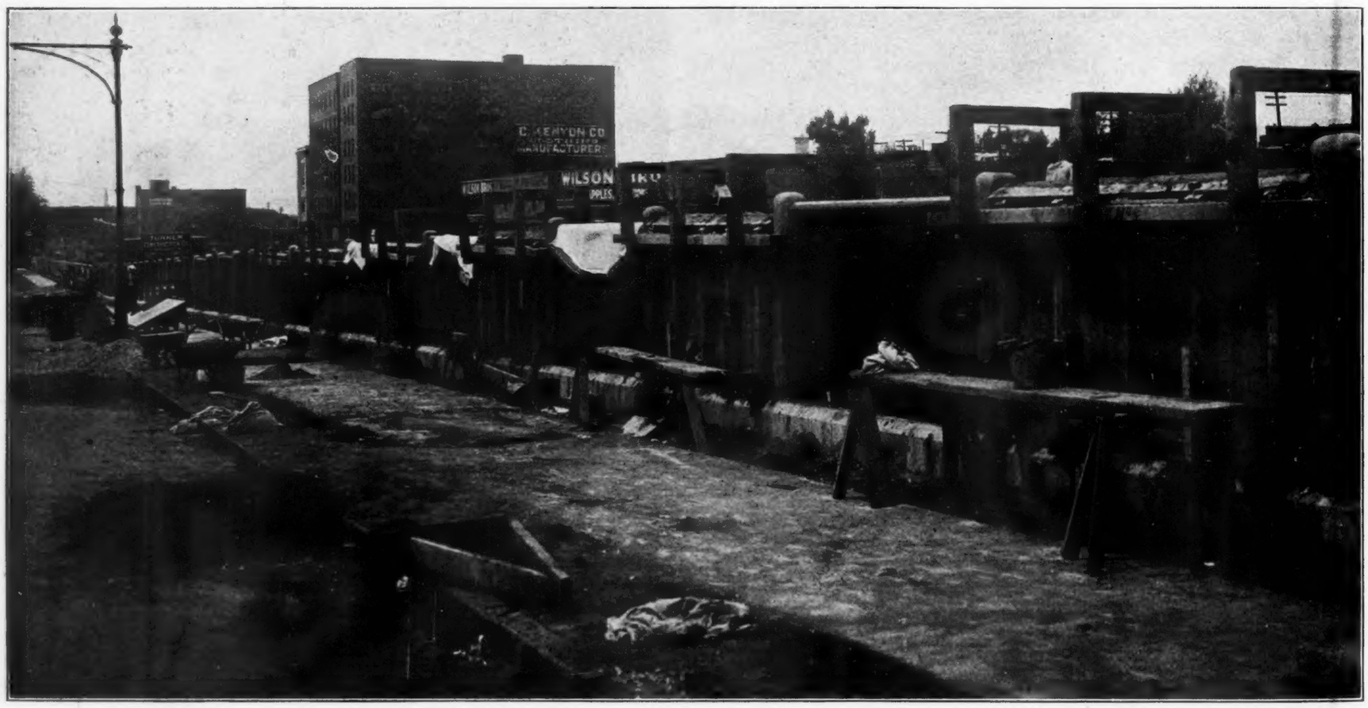


Cross Sections of Posts.



Elevation and Sections of Concrete Fence.

The cost of this fence was about $3 per lineal foot. The rate of production was about 450 lin. ft. of finished fence per week in good weather. The plans were prepared in the office of J. B. French and F. Auryansen, bridge engineers, successively, under the direction of J. R. Savage, chief engineer. The Turner Construction Company, New York, were the contractors.



Method of Casting Alternate Panels in Position.

Conventionalities

The Chicago Engineers' Club extends its hospitality and the privileges of the club to the members of the association during the convention.

One of the chief enjoyments of William R. Webster always comes in March. He meets more men in a bunch who understand rails approximately as well as he does himself than he is able to get together on any other occasion.

It is said that a house divided against itself shall not stand, but the committee on "Signaling and Interlocking" seems to stand fairly well. Each side is well buttressed, the majority by A. H. Rudd, chairman, and the minority by L. R. Clausen, vice-chairman.

The rites in connection with the work on "Masonry" were very brief—possibly because the only approach to regalia available consisted in the white sheet drapery of the official table which, by a stretch of imagination and a cloth, might be considered a continuous apron.

One of the most noticeable features of the present convention is the full attendance. Many times during the sessions practically every chair in the large hall was filled and there were, besides, several more or less complete rows of innocent by-standers along the rear of the room.

The committee on "Track" mustered 13 members to sit behind the table when its report was up. It may have been an unlucky number. It was noticed that when one vote was taken there were a few scattering votes "ay," from the floor, and a solid phalanx of "no" from the platform, with no support from the house.

Frank R. Coates, he makes rings now, though not exactly in the jewelry business. They are largely in the form of tires. However, the arduous duties of the presidency of the Interocean Steel Company have apparently not kept him from absorbing frequent and generous draughts from the fountain of perpetual youth.

The fine Boston hand of Prof. C. F. Allan appears to have operated to good advantage on the report of the committee on "Economics of Railway Location," judging from the incisive statement of technicalities involved as covered in the synopsis forming part of the official program. The professor was early on the ground and brought his genial smile with him.

It is a prevailing belief that a training in newspaper work is of advantage in almost any subsequently chosen calling. In support of this belief it may be stated that the chauffeur who has so recklessly and well driven The Daily Railway Age Gazette's limousine copy basket during the present week has been selected as the driver of President Taft's car during his stay in Chicago.

It is unfortunate that the accaustic properties of the convention hall are so bad, and yet the hall gives an interesting example of the manner in which sound will follow curved surfaces. Facing the president and the committee platform every word can be heard, as the sound apparently follows the arch of the ceiling. But along the axis of the room the sound simply refuses to travel.

T. J. Foley, heretofore assistant superintendent of the Union Pacific, with headquarters at Omaha, Neb., has been appointed assistant to Vice-President W. L. Park of the Illinois Central, with office at Chicago. For the past four years, while located at Omaha, Mr. Foley has had charge of the terminals at Omaha, Council Bluffs and South Omaha. He has also done important special work for the transportation department. He was connected with the Pennsylvania for 15 years at Fort Wayne, Ind., and later for five years in the general offices at Pittsburg. In 1902 he was appointed assistant general manager of the Baltimore & Ohio and was later superintendent and general superintendent.

When J. M. Meade, engineer of the Eastern lines of the Santa Fe, and T. Hickey, roadmaster of the Michigan Central, appeared in the session during the discussion of the report on "Track," their presence indicated the gradual drawing together of the technical and practical men interested in the proper construction and care of track. Mr. Meade remarked, "Hickey and I were in it before the flood."

A. E. Killam, inspector of bridges and buildings of the Intercolonial Railway of Canada, was noticed among the attendants of the convention. Mr. Killam is not listed as a member, but ought to be. He has been one of the most active and valuable members of the Association of Railway Superintendents of Bridges and Buildings, and his character as a genial gentleman is evidenced by the fact that he answers unhesitatingly to the name "Johnny Bull."

An unusual feature of Tuesday's session was the presence of delegations of students from nearby universities. There were four men from the engineering department of the University of Wisconsin and several from Purdue. In this early enlisting of interest in the work of the association on the part of those who are students now, but may eventually become members, we fancy we notice the influence of Herren Profassoren Turneaure, Pence and Hatt.

An innovation that is worth following in the meetings of any association in which all the members are not interested in all of the subjects or at which there is frequent going and coming, appeared in the convention hall yesterday. This consists in the provision of a series of neat signs painted in large letters and framed giving the subjects of committee reports and discussion. As one subject is disposed of the sign is removed and the proper one substituted according to the programme. The sign is hung in a conspicuous place on the wall behind the president's chair.

H. N. Turner, manager of sales, railroad department, St. Louis Surfacer & Paint Company, St. Louis, Mo., dropped from a fast train into Chicago the other day to attend the convention. He is en route to the Pacific coast to become manager of the towel supply department at the training camp of Jim Jeffries. Mr. Turner is very proud of his 120 lbs. and even more so of the fact that he has gained two ounces during the past year. Probably he is using his surfacer and paints on himself, both externally and internally. He was incorrectly reported yesterday morning among the list of exhibitors at space 214.

Aside from the usual interferences that tend to make the first session of a convention go somewhat more slowly than later sessions, there is this year a hindrance that is peculiar to the place in which the meetings are held. This is found in the high-art decorations of the Florentine ceiling. When President McNab opened the meeting and throughout the morning he was not only confronted with a sea of up-turned faces, but the faces were up-turned at such an angle as to suggest at first thought the possibility of a general prevalence of saw-toothed collars. Following the direction of some bold and some furtive glances it was discovered that eyes were quite generally riveted upon the pastoral and other scenes depicted upon the arched ceiling. These also created in some quarters a profound abstraction which militated against extended discussion. Even the contending elements in the "Signals and Interlocking" committee were partially harmonized by the soothing in-

fluence of the overheard forms of interlocking, or, better, interlocked forms; the report of the committee on "electricity" was short circuited; and it appeared to be the tacit opinion of the members that if the illustrations under inspection were in the nature of an exhibit of the committee on "Conservation of Natural Resources," resources of such nature should by all means be conserved.

The Maintenance of Way Convention adjourned at 4 o'clock Tuesday afternoon so that the members of the Association could go to the Coliseum to see the exhibits. The members had been preceded by one of the largest crowds that ever attended such an exhibition, and the addition to the crowds of the Association members comfortably filled the aisles of the Coliseum. The early adjournment of the session and the large attendance of engineers has been particularly gratifying to the exhibitors as a mark of appreciation of the great efforts made to make the exhibition not only attractive but interesting and instructive as well.

"What's the engineer a-groanin' for?" asked the Stranger on Parade.
"'Is turn 'as come, 'is turn 'as come," the news man sadly said.
"What makes you look so sad, so sad," said the Stranger on Parade.
"I'm dreadin' what I've got to see," the news man sadly said.
"For they'll do the engineer up brown—my, but they're feelin' gay;
They'll give 'im all the dope they've got, 'e can never get away.
For they've got 'im where they want 'im, and there 'e'll 'ave to stay,
And they'll do 'im good and plenty till the mornin."

"What makes that fellow look so glad?" said the Stranger on Parade.
"'E's specified, 'e's specified," the news man softly said.
"What makes that next man glare at 'im" said the Stranger on Parade.
"E's lost 'is chance, 'e's lost 'is chance," the news man sadly said.
"They'll do the engineer all 'round, now they've got 'im in their 'ands;
They've got 'im at a table now, and the man that's waitin' stands
And 'e's askin' what they're goin' to 'ave, namin' sev'ral diff'rent brands,
And there's like to be some 'eadaches in the morin'."

"'Is sleepin' room is next to mine," said the Stranger on Parade.
"'E'll never use 'is room to-night," the news man sadly said.
"I've 'eard 'im come in sev'ral nights," said the Stranger on Parade.
"'E'll not come in at all to-night," the news man sadly said;
"For the engineer's bamboozled, 'e's 'ad sev'ral kinds of booze,
'E's just lit up a half-burned stub—'e didn't notice whose—
And a couple hours longer'll be enough to cook 'is goose,
And 'e'll come 'ome in a carriage in the mornin'."

"What is the cause of all the noise?" said the Stranger on Parade.
"They're tryin' to take 'im to a cab," the news man sadly said.
"What's that they're puttin' in 'is 'and?" said the Stranger on Parade.
"A list of orders that 'e's placed," the news man sadly said.
"For they've done just all they can to 'im; I 'eard one of them say,
They'd time to do another one and they're feelin mighty gay,
For this is just the season when they make their crop of hay,
But they'll feel like six bad nickels in the mornin'."

The American Railway Signal Company has just installed an electric interlocking plant at Lindale, Ohio, at the crossing of the Cleveland Short Line and the Big Four. There is a 48-lever frame with 26 working levers, controlling three switches, nine derails, four two-arm signals, two three-arm signals, four distant signals and three dwarf signals. The plant is equipped with electric dectector and route locking in addition to detector bars. The signals on the Short Line are upper quadrant, three-position, semi-automatic. The other signals are lower quadrant. Secondary circuits are controlled by 12 volts from storage battery. The battery is the chloride accumulator type, 120 ampere-hours, and is charged from a Northwestern generator driven by an Alamo gasoline engine. The distant signals on the Short Line have no separate levers. The American Railway Signal Company is also installing at Parma, Ohio, a 62-lever electric interlocking machine with 41 working levers, at the crossing of the Baltimore & Ohio and the Cleveland Short Line. All signals on the Short Line are three-position, upper quadrant, slotted. The plant is equipped with detector bars and electric detector and approach locking. Gasoline engine and generator and storage battery are the same as in the previous plant. The American Railway Signal Company is also installing at St. Cloud, Minn., at the crossing of the Northern Pacific and the Great Northern, a 54-lever electric interlocking machine with 35 working levers. All signals are three-position, upper quadrant. The plant is equipped with detector bars and complete electric locking. The gasoline engine, generator and storage battery are the same as in the other plants. All these plants are provided with annunciators and block indicators.

MR. HOOLEY ON THE RAILWAY EXHIBIT.

"What's this show that's goin' on 't th' Collyseeum now?" inquired Mr. Dinnissey as he strolled into Mr. Hooley's thirst parlor for his "mornin's mornin'."

"'Tis th' exybit av th' engineers' tools that I was tellin' ye about th' other day."

"I t'ort ye sid th' engineers didn't do nothin' but make th' pitchers, 'nd misure th' mountains 'nd till th' min that do th' wurruk what to do 'nd how to do ut, 'nd th' aljaybry wurruk that I don't know what 'tis, 'nd th' like o' that," said Mr. Dennissey.

'I towld ye, Dinnissey, that uv ye thought annything was so 'twouldn't be so," said Mr. Hooley as he glanced sternly at the glass which Mr. Dinnissey had tried to cover with his hand. "Th' aljaybry wurruk 's th' figgerin' before th' min do th' rale wurruk 'nd they use litthers 'nstid av figgers so't iv they get th' figgers wrong th' foorst time they c'n change 'em 'nd ye can't till what th' change is cause ye don't know what th' litthers is worth. T' illusthrate," continued Mr. Hooley, making a personal application of his remarks for the sake of the more permanent impression. "T' illusthrate: Iv I putt down what ye owe me f'r goods as ay, bay, say, wan time 'nd thin agin with some Yiddish litthers that ye don't know th' mainin' av——"

"Ye don't know thim ayther," retorted Mr. Dinnissey.

"'Tis merely f'r purposes av illusthration I'm shpakin' av

thim things that makes a pa-aper luk like a laundhry chick. Iv I putt down ay, bay, say, wan day, 'nd thin some Yiddish marks th' nixt 'nd thin add thim up 'nd putt down ix, why, zed, ye don't know how much ye owe me, do ye, Dinnissey? Ye don't annyway, but ye say, th' litthers riprisint annything I want thim to mane, 'nd iv ye're flush wan month, th' litthers mane more to me cash drar thin they do whin ye have no money, though I'm thinkin' ye'er tab's gettin' that long that ix, why, zed, don't mane much more'n ye'er laundhry does whin ye've lost the Chink's chick. But 's ye say, th' litthers is flixible 'nd admit av changes whin a mishtake is made, f'rinstance, like in the lingth av th' tunnel I towld ye about that shticks out av th' mountain on th' both sides.

"But ye were wantin' to know about th' exybit at the Collyseum. Thim's th' movible fixures av the relrod thrack that th' engineers have to ricommind whin th' prisidint 'nd gn'ral manager's directhors in th' comp'ny that makes 'em. They're brought here 'nd sprid out so't th' relrod min c'n ricognize thim 'nd not ordher th' things that's made be th' comp'ny that's got its directhors fr'm a compatin' road. Ye say, Dinnissey, that th' relrod business 's got to that point fr'm th' rigilation av Congriss 'nd th' ligislachoors 'nd th' Int'rsthate Commerce C'mission, that there a'n't anny more money in runnin' a relroad 'nless there's a chanst f'r graft on th' side. Sometimes it's wan way, 'nd sometimes it's another. Iv th' gin'ral orfisers c'n form a comp'ny t' make th' things th' relrod comp'ny has to buy, ye say 't's th' sthockholders that have t' pay f'r thim 'nd th' orfisers gets th' profut f'r th' goods. That's th' only way that relrodin' pays in these days, Dinnissey. Wanst in a while it pays to divide th' profuts fr'm th' manufacturin' wit' th' sthockholders 'nd bull th' sthock in Wall street so't some wan man av th' orfisers c'n unload whin th' market's good 'nd make up f'r th' money 't they lost in payin' a dividind. They take turns at ut, Dinnissey, 'nd whin a man gits old he c'n retire on a compethence 'nd lave a chanst to move up th' other orfisers 'nd make room f'r th' old man's son 't th' bottom or 't th' top, 'cordin' to th' old man's inflooence wit' th' rist.

"Where does th' engineer come in?" inquired Mr. Dennissey.

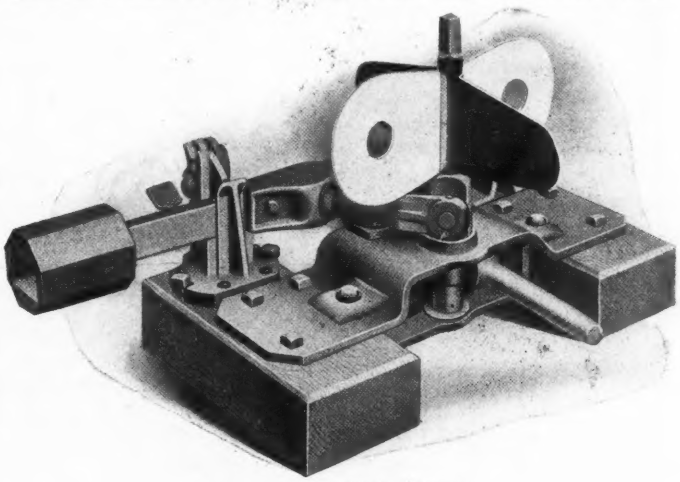
"He don't come in at arl, 'nless he invints a signal, 'r a rail joint, 'r a simmyfor, 'r a wather spout, 'r a hand car that he c'n spisify in his rekisitions 's th' bist 'nd only thing av th' kind that he c'n use owin' to th' pecooliar c'nditions av the road he wurruks f'r. Av coorse, he guts paid f'r his aljaybry wurruk 'nd 's th' other orfisers don't know nothin' av th' valoo av th' litthers he uses in th' place av th' figgers he c'n make his istimates 's he plases 'nd make ut worth while f'r th' couthractor 'r th' manufacthurer t' whack up with 'im. 'nd they get r'yalties fr'm th' wans that make th' invintions. 'Tis a good thrade, is th' engineerin', 'nd I'm thinkin' I'll sind me bye to wan av thim take-a-nickel schools. That's what they call thim schools where they take th' byes that's betther at th' figgerin' than they be at th' readin' 'nd ritin' 'nd th' hist'ry 'nd th' langwidges. A good manny av th' engineers don't find it nicissary t' bother wit' th' inthricacies av English, 'nd grammar 'nd capital litthers 'nd poonctuashun, 'nd they don't have time at the schools nayther. 'Twould pay ye, Dinnissey, t' sneak ye'er way int' th' Collyseeum 'nd look over th' exybit. Maybe ye cud find out th' differens bechune a simmyfor 'nd a wather spout, 'nd ye might not expayrience much difficulty in th' case av a hand car 'nd a whalebarrow. Thin they's switches 'nd frogs, 'nd rale j'ints 'nd imitation j'ints, 'nd culverts—thim's holes made out av conchrate f'r th' wather to run through undher th' thrack—'nd iverything th' relrod uses on th' right-av-way ixcipt wades. Th' wades they don't like, 'nd they's a masheen like a sassige grinder what pulls thim up be th' ruts 'nd cuts thim to paces to make ballast av. 'Tis a grea-at show, Dinnissey, 'nd av ye like I'll say me frind Jawn Reynolds 't's th' main guy there 'nd get ye a pass. Wud ye like to go, Dinnissey?"

"I wud that. I wud go," replied Mr. Dinnissey. "But ye were sayin' about th' graft, Misther Hooley. I've rid about th' min that got caught f'r buyin' coal fr'm comp'nies 't they owned, 'nd at th' clarks that got rich at sixty dollars a month fr'm knowin' where to place orders f'r coal 'nd grain dures. But I don't raymimber that I iver heard av an engineer that was caught gettin' rich faster thin th' law allowed. C'n y'explain that, Misther Hooley?"

"'Tis aisy, Dinnissey. 'S I was a-tellin' ye, they're ijukated in th' take-a-nickel schools. They're arl will-ijukated min," replied Mr. Hooley, pleased to be able to explain and remarking something about a tin roof, as it would be on the house.

G. L. M. SWITCH STAND.

The Morden Frog & Crossing Co., Chicago, has on exhibition in booth 86 at the Coliseum two new types of parallel ground throw G. L. M. switch stands. These stands



G. L. M. Switch Stand.

are built either rigid or automatic, as desired; they are made of plate steel or malleable iron and there are no bevel gears. The makers claim that these stands will maintain their initial throw until practically worn out.

LOVELL WINDOW OPERATOR.

In the accompanying illustration is shown an installation of the Lovell window operator recently completed by the G. Drouve Company, Bridgeport, Conn., in the erecting and machine shop building of the Delaware, Lackawanna & Western shops at Scranton, Pa. The total length of this installation is 7,840 lineal feet. Among other railway companies which have recently installed this window operator are the Pennsylvania, Lake Shore & Michigan Southern, New York Central & Hudson River, and Atchison, Topeka & Santa Fe.

This operator will open and close any number of windows in runs of 100, 200 or more lineal feet. The push and pull principle is used instead of a twisting movement. It is claimed that a window at the far end of the building will open equally as well as any other. The small number of fittings required are well made and of standard shapes, giving the maximum strength. The Lovell bracket, which holds the operating rod, is of steel and can be extended to meet varying conditions. Small wheels are used as guides for operating the rod, giving easy action. The operating rod is of standard size steel pipe and for each run is connected into one continuous piece. The arms that fasten to the

window and operating rod are made of pressed steel and wrought iron piping. The operating arms are fastened to the main rods with open adjustable couplings, and to the window framing by universal joints designed to prevent binding. A rack and and opinion is used with a large wheel from which is extended a chain or wire cable for operating the device. A rolling motion occurs in operation, carrying practically no strain to the operating wheel.

The Lovell window operator is easy to install, and will operate the following kinds of construction: Monitor, lantern, side sash, side frames, saw-tooth windows and pivoted or hinged sash. Either horizontal or vertical arrangements are provided for and operate with equal facility. The application of this operating device permits ventilation regulation. Windows that may bind can be readily cut out of the line by detaching the open couplings of the arms from the rods. In case of fire, with this arrangement for operating sash in long runs, an immediate closing of windows from few stations will check the draught.

Lovell Window Operator at Scranton Locomotive and Erecting Shop; Delaware, Lackawanna & Western.

LIDGERWOOD INCLINE COAL CAR HAUL HOISTS FOR COALING STATIONS.

A coaling station embodying an elevated pocket from which the coal is drawn by gravity through chutes is probably the best design for obtaining rapid delivery into the tender.

About thirteen or fourteen years ago, the Great Northern conceived the idea of shortening the length of the old style incline and hoisting the coal up by a powerful geared machine. It was also decided to operate the hoist by a gas engine, as such is available for use at any time, requires no firemen and does not have the inconveniences of maintaining steam for infrequent use, especially in temperatures which are extreme during the winter season. Since this early experience, a great majority of western railways have adopted this form of coaling station as a standard. Various improvements have been made in the hoisting machines with the intention of increasing their length of service. These stations are being built to handle 150,000-lb. cars up a 20 per cent. grade, inolving a pull at the drum of 36,000 lbs. at a speed of 20 feet per minute. The most recent large installations use a hoisting speed of 30 feet to 40 feet per minute.

In the majority of cases in isolated locations, the hoisting machine is operated by a gas engine, but in numerous terminal locations electricity has been used, the motor being direct connected with suitable spur gearing to the hoisting drum. A steam engine is also frequently employed, in which case double cylinders, 8¼-in. by 10 in. are used, direct geared to the hoist. One of the present up to date type hoists of this class is on exhibition in space 206, and represents a type, a large number of which have been furnished by the Lidgerwood Manufacturing Co. of New York.

These hoists are designed for hauling loaded coal cars weighing from 100,000 to 150,000 lbs. up inclines to the pockets for coaling locomotives. They may be driven by steam engines, electric motors, or gas engines, either directly connected, or by sprocket or rope drives. These hoists are geared at a ratio of 32.2 to 1 and have a rated capacity of 36,000 lbs. rope pull at the drum at a speed of 20 ft. per minute, which provides for hauling loaded cars up an incline with a 20 per cent. grade.

The hoists are provided with powerful differential band brakes on the drums, spiral square jawed clutches on the intermediate shafts, frictions on the driven shafts, and automatic band brakes on the driven shaft pinion which comes into instant action to hold a car in any position in case of accident or failure of power. The hoist is mounted on the timber structure of the pocket. The bed consists of two side pieces, each carrying bearings for the three shafts. The intermediate shaft and driven shaft have three bearings each, the center ones being in pillow blocks, mounted on the central timber of the foundation.

The drum is 40 in. in diameter, with a 44-in. base, grooved for the $1\frac{1}{4}$-in. wire rope. On the gear side it has a 48-in. flange, through which it is bolted to the main gear wheel. At the opposite end, the flange is 60 in. in diameter and the outside rim, supported by heavy ribs, carries the band brake for lowering empty cars. The drum and gear wheel are keyed to the 6-in. forged steel shaft. The main gear wheel is 77 in. pitch diameter, with a $6\frac{1}{2}$-in face, and has 80 teeth of three-inch pitch. The shrouded pinion is $12\frac{1}{2}$ in.-diameter with a $7\frac{1}{2}$-in. face and has 13 teeth. The intermediate shaft is of machinery steel $4\frac{3}{8}$ in. in diameter. The intermediate gear wheel is 38 in. diameter with a 5-in. face and has 68 teeth of $1\frac{3}{4}$-in. pitch. This bronze bushed intermediate gear runs loose on the shaft and carries on its hub one part of a spiral cut jaw clutch. The other part of the clutch moves on a feather on the shaft. The clutch lever quadrant is mounted on the cap of the outer shaft bearing. The shrouded pinion on the driven shaft has 13 teeth. A flange is cast upon this pinion for a 24-in. friction and upon this flange is also the face for the automatic band brake. The bronze bushed pinion runs loose upon its shaft. A friction plate, carrying the friction woods, slides on a feather on the shaft. The friction has patent cork inserts and is operated by the regular Lidgerwood friction screw, friction pin, crosskey, and hand lever. A positive releasing device insures the withdrawal of the friction plate when the lever is thrown to the "off" position.

The main brake is operated by a lever provided with hand lever brasses and a saw-notched quadrant, suitably mounted on the hoist. The automatic brake on the driven shaft pinion, of the differential band type, is set up by an adjustable spring. It has a lifting lever by which the operator may release it, and it may also be used instead of the main brake for allowing empty cars to run down the incline. The short end of the lever has a stop which prevents the brake from being opened more than is necessary to release its hold.

Space is provided between the center and side bearings for the sprocket wheel, rope pulley or gear connections, and the driven shaft may be extended outside the bed for motor connections.

REGISTRATION — MAINTENANCE OF WAY ASSOCIATION.

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Smith, Sherman, Asst. Eng., Grand Trunk Pac. Ry., Earl, Sask.
Stevens, E. S., Asst. Eng., B. & O. R. R., Pittsburg, Pa.
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Von Schrenk, Herman, Dr., Supr. Timber Pres., Rock Island-Frisco Rys., St. Louis, Mo.

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Willoughby, J. E., Eng. of Const., L. & N. R. R., Louisville, Ky.
Woods, A. A., Res. E., A. & V. and V. S. & P. Rys., Vicksburg.
Woods, H. A., Asst. Ch. Eng., Gr. Tr. Pac. Ry., Montreal.
Zinck, K. J. C., Asst. Eng., G. T. Pac., Winnipeg, Man.

ASSOCIATE MEMBERS.

Buehler, Walter, Consulting Eng., Kettle River Quar. Co., St. Louis, Mo.
Wolfel, P. L., Ch. Eng., McClintic-Marshall Co., Rankin, Pa.

GUESTS.

Ackenheil, A. C., C. E., Pittsburg.
Albright, C. C., Asst. Prof. Civil Eng., Purdue Univ., Lafeyette, Ind.
Bement, W. B., Wis. Ry. Cos., Madison, Wis.
Brannon, C., Asst. Div. Eng., E. & T. H. R. R., Evansville, Ind.
Christian, W. A., Asst. Eng., C. G. W. R. R., Chicago, Ill.
Dewees, A. R., Asst. Eng., P. M. Ry., Saginaw, Mich.
Gennet, C. W., Jr., R. W. Hunt Co., Chicago.
Goetz, Frederick, Gen. Roadmaster, Mil. Elec. Ry. & Light Co., Milwaukee.
Gordon, H. L., Asst. Eng., B. & O. R. R., Baltimore.
Harvey, W. C., Asst. Eng., Chicago G. W. Ry., Chicago.
Harvey, W. F., Board of Local Improvements, Chicago.
Herrold, G. H., Eng. M. W., C. G. W. R. R., Chicago, Ill.
Hoskins, F. G., Asst. Eng., B. & O. R. R., Pittsburgh.
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Lawton, L. C., Div. Eng., A., T. & S. F. Ry., Newton, Kan.
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McCalman, D., Asst. Eng., Chicago G. W. Ry., Chicago.
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Wiggins, W. D., Eng. M. of W., Pennsylvania Lines, Pittsburg.
Wirth, A. A., Eng. M. of W., Penna. Lines, Pittsburg, Pa.

MAINTENANCE OF WAY COMMITTEES FOR 1910.

I—Committee on Roadway.

George H. Bremner (Chairman), Engineer, Illinois District, Chicago, Burlington & Quincy.
S. B. Fisher (Vice-Chairman), Chief Engineer, Missouri, Kansas & Texas.
J. R. W. Ambrose, Assistant Engineer, Grand Trunk.
John C. Beye, Locating Engineer, Chicago, Rock Island & Pacific.
D. J. Brumley, Principal Assistant Engineer, Illinois Central.
Moses Burpee, Chief Engineer, Bangor & Aroostook.
W. C. Curd, Assistant Engineer, Missouri Pacific.
W. M. Dawley, Assistant Engineer, Erie.
Walt Dennis, Office Engineer, Kansas City Southern.
Paul Didier, District Engineer, Baltimore & Ohio.
C. Dougherty, Engineer Maintenance of Way, Cincinnati, New Orleans & Texas Pacific.
D. McPherson, Assistant Chief Engineer, National Transcontinental.
W. D. Pence, Professor of Railroad Engineering, University of Wisconsin.
H. J. Slifer, General Manager, Chicago Great Western.
J. A. Spielmann, Engineer Maintenance of Way, Baltimore & Ohio.
John G. Sullivan, Assistant Chief Engineer, Canadian Pacific.
J. E. Willoughby, Engineer of Construction, Louisville & Nashville.
W. P. Wiltsee, Assistant Engineer, Norfolk & Western.
R. C. Young, Chief Engineer, Lake Superior & Isheming and Munising.

II—Committee on Ballast.

John V. Hanna (Chairman), Chief Engineer, Kansas City Terminal.
C. A. Paquette (Vice-Chairman), Assistant Chief Engineer, Cleveland, Cincinnati, Chicago & St. Louis.
F. J. Bachelder, Division Engineer, Baltimore & Ohio.
W. J. Bergen, Assistant to Chief Engineer, New York, Chicago & St. Louis.
J. S. Lemond, Engineer Maintenance of Way, Southern.
C. B. Brown, Jr., Division Engineer, Canadian Pacific.
J. M. Egan, Roadmaster, Illinois Central.
H. E. Hale, Principal Assistant Engineer, Missouri Pacific.
G. D. Hicks, Superintendent, Nashville, Chattanooga & St. Louis.
C. T. Brimson, Engineer Maintenance of Way, Quincy, Omaha & Kansas City.
C. C. Hill, Division Engineer, Michigan Central.
J. M. Meade, Engineer Eastern Lines, Atchison, Topeka & Santa Fe.
C. S. Millard, Engineer Maintenance of Way, Cleveland, Cincinnati, Chicago & St. Louis.
F. J. Stimson, Engineer Maintenance of Way, Grand Rapids & Indiana.
S. N. Williams, Professor of Civil Engineering, Cornell College.

III—Committee on Ties.

E. E. Hart (Chairman), Chief Engineer, New York, Chicago & St. Louis.
W. F. H. Finke (Vice-Chairman), Tie and Timber Agent, Southern.
A. F. Dorley, Division Engineer, Missouri Pacific.
L. A. Downs, Assistant to Chief Engineer Maintenance of Way, Illinois Central.

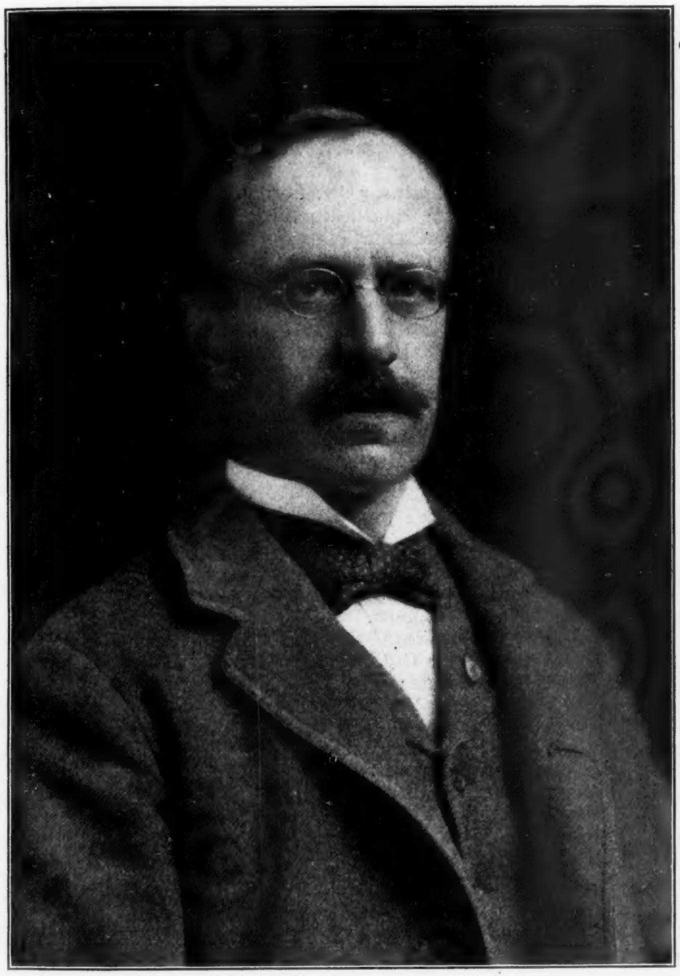
L. C. FRITCH,
Incoming President.

W. F. Goltra, Tie Agent, New York Central Lines.
E. D. Jackson, Assistant Engineer, Baltimore & Ohio.
F. G. Jonah, Chief Engineer Construction, St. Louis & San Francisco.
H. C. Landon, Division Engineer, Erie.
Edward Laas, Engineer Maintenance of Way, Chicago, Milwaukee & St. Paul.
F. R. Layng, Engineer of Track, Bessemer & Lake Erie.
G. W. Merrell, Assistant to General Manager, Norfolk & Western.
L. M. Perkins, Division Engineer, Northern Pacific.
H. S. Wilgus, Engineer Maintenance of Way, Pittsburg, Shawmut & Northern.

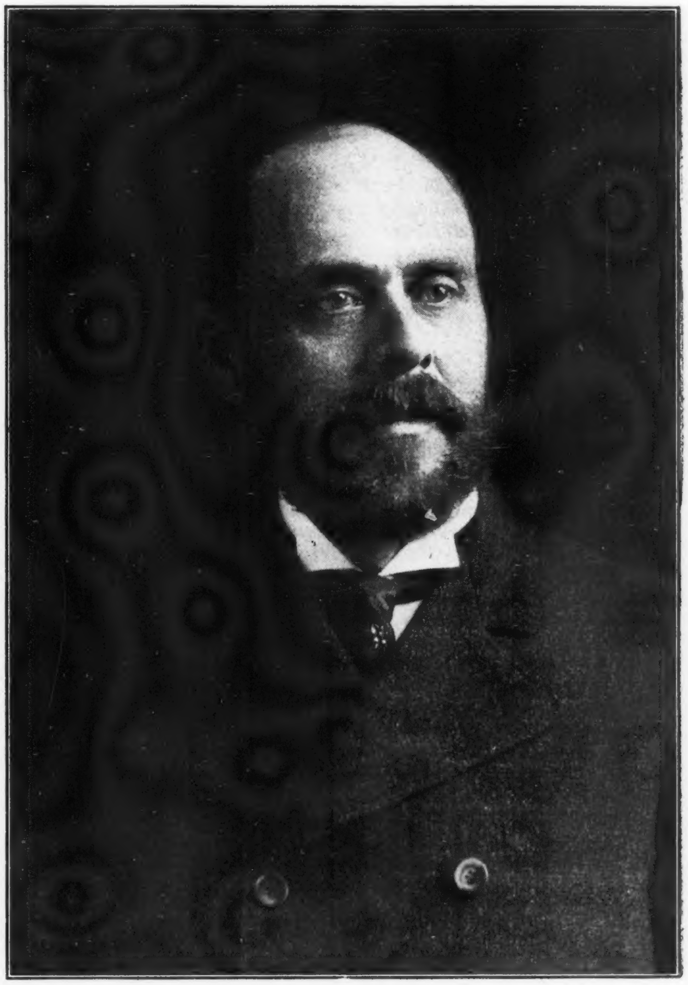
IV—Committee on Rail.

Charles S. Churchill (Chairman), Chief Engineer, Norfolk & Western.
R. Montfort (Vice-President), Consulting Engineer, Louisville & Nashville.
Robert Trimble (Secretary), Chief Engineer Maintenance of Way, Northwest System, Pennsylvania Lines.
E. B. Ashby, Chief Engineer, Lehigh Valley.
J. A. Atwood, Chief Engineer, Pittsburg & Lake Erie.
A. S. Baldwin, Chief Engineer, Illinois Central.

J. B. Berry, Chief Engineer, Chicago, Rock Island & Pacific.
M. L. Byers, Chief Engineer Maintenance of Way, Missouri Pacific.
W. C. Cushing, Chief Engineer Maintenance of Way, Southwest System, Pennsylvania Lines.
F. A. Delano, President, Wabash.
Dr. P. H. Dudley, Rail Expert, New York Central & Hudson River.
C. H. Ewing, Engineer Maintenance of Way, Philadelphia & Reading.
John D. Isaacs, Consulting Engineer, Harriman Lines.
Thos. H. Johnson, Consulting Engineer, Pennsylvania Lines.
Howard G. Kelley, Chief Engineer, Grand Trunk.
J. W. Kendrick, Vice-President, Atchison, Topeka & Santa Fe.
George W. Kittredge, Chief Engineer, New York Central & Hudson River.
C. B. Hoyt, Superintendent Track, New York, Chicago & St. Louis.
John R. Leighty, Engineer Maintenance of Way, Missouri Pacific.
J. C. Nelson, Engineer Maintenance of Way, Seaboard Air Line.
P. C. Newbegin, Maintenance Engineer, Bangor & Aroostook.
R. M. Pearce, Resident Engineer, Pittsburg & Lake Erie.
H. T. Porter, Chief Engineer, Bessemer & Lake Erie.
G. J. Ray, Chief Engineer, Delaware, Lackawanna & Western.
William G. Raymond, Dean, State University of Iowa.
S. S. Roberts, Assistant Professor of Railroad Engineering, University of Illinois.
L. S. Rose, Signal Engineer, Cleveland, Cincinnati, Chicago & St. Louis.
F. A. Smith, Civil Engineer.



W. C. CUSHING,
Incoming First Vice-President.



CHAS. S. CHURCHILL,
Incoming Second Vice-President.

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Joseph T. Richards, Chief Engineer Maintenance of Way, Pennsylvania.
J. P. Snow, Chief Engineer, Boston & Maine.
A. W. Thompson, Chief Engineer Maintenance of Way, Baltimore & Ohio.
M. H. Wickhorst, Chicago, Burlington & Quincy. (Appointed Engineer of Tests for Rail Committee.)

V—Committee on Track.

C. E. Knickerbocker (Chairman), Engineer Maintenance of Way, New York, Ontario & Western.
J. B. Jenkins (Vice-Chairman), Assistant Engineer, Baltimore & Ohio.
E. C. Blundell, General Roadmaster, Chicago, St. Paul, Minneapolis & Omaha.
Garrett Davis, Superintendent Chicago, Rock Island & Pacific.
J. L. Downs, Roadmaster, Yazoo & Mississippi Valley.
R. C. Falconer, Assistant Engineer, Erie.
T. H. Hickey, Roadmaster, Michigan Central.
R. H. Howard, Engineer Maintenance of Way, Chicago & Eastern Illinois.
R. A. Van Houten, Division Engneer, Lehigh Valley.
W. D. Wiggins, Division Engineer, Pennsylvania Lines.

VI—Committee on Buildings.

O. P. Chamberlain (Chairman), Chief Engineer, Chicago & Illinois Western Railway, Chicago, Ill.
Maurice Coburn (Vice-Chairman), Principal Assistant Engineer, Vandalia Line.
George W. Andrews, Inspector of Maintenance, Baltimore & Ohio.
J. P. Canty, Supervisor Bridges and Buildings, Boston & Maine.
D. R. Collin, Architect, New York Central & Hudson River.
H. M. Cryder, St. Louis.
William T. Dorrance, District Engineer, New York Central & Hudson River.
C. H. Fake, Chief Engineer, Mississippi River & Bonne Terre.
P. F. Gentine, Division Engineer, Missouri Pacific.
E. N. Layfield, Chief Engineer, Chicago Terminal Transfer.
M. A. Long, Architect, Baltimore & Ohio.
John S. Metcalf, Civil Engineer.
H. Rettinghouse, Division Engineer, Chicago & Northwestern.
C. W. Richey, Master Carpenter, Pennsylvania.

VII—Committee on Wooden Bridges and Trestles.

H. S. Jacoby (Chairman), Professor of Bridge Engineering, Cornell University.
F. H. Bainbridge (Vice-Chairman), Resident Engineer, Chicago & Northwestern.
F. E. Bissell, Civil Engineer.
W. S. Bouton, Engineer of Bridges, Baltimore & Ohio.
R. D. Coombs, Structural Engineer, Pennsylvania Tunnel & Terminal.
L. J. Hotchkiss, Assistant Bridge Engineer, Chicago, Burlington & Quincy.
Hans Ibsen, Bridge Engineer, Michigan Central.
J. A. Lahmer, Principal Assistant Engineer, Kansas City Southern.
F. B. Scheetz, Assistant Engineer, Missouri Pacific.
G. R. Talcott, Assistant Engineer, Baltimore & Ohio.
C. C. Wentworth, Principal Assistant Engineer, Norfolk & Western.
P. H. Wilson, Civil Engineer.
I. L. Simmons, Bridge Engineer, Chicago, Rock Island & Pacific.

VIII—Committee on Masonry.

W. H. Peterson (Chairman), Bridge Engineer, Chicago, Rock Island & Pacific.
G. H. Tinker (Vice-Chairman), Bridge Engineer, New York, Chicago & St. Louis.
W. J. Backes, Chief Engineer, Central New England.
G. J. Bell, Division Engineer, Atchison, Topeka & Santa Fe.
C. W. Boynton, Inspecting Engineer, Universal Portland Cement Company.
W. H. Chadbourn, Principal Assistant Engineer, Chicago Great Western.
W. W. Colpitts, Chief Engineer, Kansas City, Mexico & Orient.
T. L. Condron, Consulting Engineer.
B. Douglas, Tunnel Engineer, Detroit River Tunnel Company.
L. N. Edwards, Assistant Engineer, Grand Trunk.
A. H. Griffith, Assistant Engineer, Baltimore & Ohio.
Richard L. Humphrey, Consulting Engineer.
R. T. McMaster, Inspecting Engineer, Pittsburg & Lake Erie.
C. H. Moore, Engineer of Grade Crossings, Erie.
F. E. Schall, Bridge Engineer, Lehigh Valley.
A. N. Talbot, Professor Municipal and Sanitary Engineering, University of Illinois.
F. L. Thompson, Assistant Engineer of Bridges, Illinois Central.
Job Tuthill, Engineering Maintenance of Way, Cincinnati, Hamilton & Dayton.

IX—Commitee on Signs, Fences and Crossings.

W. D. Williams (Chairman), Chief Engineer, Cincinnati Northern.
K. J. C. Zinck (Vice-Chairman), Assistant Engineer, Grand Trunk Pacific.
A. M. Funk, Division Engineer, Baltimore & Ohio.
E. R. Lewis, Division Engineer, Michigan Central.
W. H. Hoyt, Assistant Chief Engineer, Duluth, Missabe & Northern.
Joseph Mullen, Engineer Maintenance of Way, Cleveland, Cincinnati, Chicago & St. Louis.
W. J. Burton, Division Engineer, Missouri Pacific.
C. H. Stein, Engineer Maintenance of Way, Central of New Jersey.
E. J. Steinbeck, Assistant Engineer, Illinois Central.

X—Committee on Signals and Interlocking.

A. H. Rudd (Chairman-Director), Signal Engineer, Pennsylvania.
L. R. Clausen (Vice-Chairman), Superintendent, Chicago, Milwaukee & St. Paul.
Azel Ames, Train Control Board.
C. C. Anthony, Assistant Signal Engineer, Pennsylvania.
H. Baker, General Manager, Queen and Crescent Route.
H. S. Balliet, Signal Engineer, Electric Zone, New York Central & Hudson River.
W. G. Besler, Vice-President and General Manager, Central of New Jersey.
H. S. Cable, General Superintendent, Chicago, Rock Island & Pacific.
W. B. Causey, Superintendent, Chicago Great Western.
C. A. Christofferson, Signal Engineer, Northern Pacific.
C. E. Denney, Signal Engineer, Lake Shore & Michigan Southern.
W. J. Eck, Electrical Engineer, Southern.
W. H. Elliott, Signal Engineer, New York Central & Hudson River.
W. J. Harahan, Assistant to President, Erie.
M. H. Hovey, Wisconsin Railroad Commission.
A. S. Ingalls, Assistant General Superintendent, Lake Shore & Michigan Southern.
J. C. Mock, Electrical Engineer, Detroit River Tunnel Company.
F. P. Patenall, Signal Engineer, Baltimore & Ohio.
J. A. Peabody, Signal Engineer, Chicago & Northwestern.
Frank Rhea, Engineer for Signal Department, General Electric Company.
W. B. Scott, Assistant Director Maintenance and Operation, Harriman Lines.
Thomas S. Stevens, Signal Engineer, Santa Fe.
J. E. Taussig, Terminal Superintendent, Wabash.
H. H. Temple, Superintendent, Baltimore & Ohio.
J. C. Young, Signal Engineer, Union Pacific.
Edwin F. Wendt, Assistant Engineer, Pittsburg & Lake Erie.

XI—Committee on Records and Accounts.

H. R. Safford (Chairman), Chief Engineer Maintenance of Way, Illinois Central.
H. J. Pfeifer (Vice-Chairman), Engineer Maintenance of Way, Terminal Railroad Association.
J. M. Brown, District Engineer, Chicago, Rock Island & Pacific.
M. C. Byers, Chief Engineer, St. Louis & San Francisco.
A. L. Davis, Assistant Engineer, Illinois Central.
T. H. Gatlin, Engineer Maintenance of Way, Southern.
C. H. Gerber, Consulting Engineer.
Edward Gray, Engineer Maintenance of Way, Southern.
Henry Lehn, Maintenance of Way Accountant, New York Central & Hudson River.
Thomas Maney, General Roadmaster, Louisville & Nashville.
J. H. Milburn, Chief Draftsman, Baltimore & Ohio.
C. W. Pifer, Roadmaster, Illinois Central.
W. H. Sellew, Principal Assistant Engineer, Michigan Central.
J. E. Turk, Superintendent, Philadelphia & Reading.
R. W. Willis, Engineer, Missouri District, Chicago, Burlington & Quincy.

XII—Committee on Rules and Organization.

Joseph O. Osgood (Chairman), Chief Engineer, Central of New Jersey.
F. L. Nicholson (Vice-Chairman), Engineer Maintenance of Way, Norfolk & Southern.
F. D. Anthony, Chief Engineer, Quebec, Montreal & Southern.
G. D. Brooke, Division Engineer, Baltimore & Ohio.
S. E. Coombs, Assistant Engineer, New York Central & Hudson River, New York.
B. T. Elmore, Assistant Chief Engineer, Virginian.
A. S. More, Engineer Maintenance of Way, Cleveland, Cincinnati, Chicago & St. Louis.
G. L. Moore, Engineer Maintenance of Way, Lehigh Valley.
J. F. Deimling, Chief Engineer, Pere Marquette.
D. B. Johnston, Division Engineer, Pennsylvania.
A. J. Neafie, Principal Assistant Engineer, Delaware, Lackawanna & Western.

XIII—Committee on Water Service.

C. L. Ransom (Chairman), Resident Engineer, Chicago & Northwestern.
Robert Ferriday (Vice Chairman), Engineer Maintenance of Way, Cleveland, Cincinnati, Chicago & St. Louis.
James Burke, Engineer Maintenance of Way, Erie.
J. L. Campbell, Engineer Maintenance of Way, El Paso & Southwestern.
H. M. Church, Division Engineer, Baltimore & Ohio Southwestern.
G. H. Herrold, Engineer Maintenance of Way, Chicago Great Western.
E. G. Lane, Engineer Maintenance of Way, Baltimore & Ohio.
A. Mordecai, Consulting Engineer.
C. A. Morse, Chief Engineer, Atchison, Topeka & Santa Fe.
W. A. Parker, Chief Engineer, St. Joseph & Grand Island.
L. P. Rossiter, Division Engineer, Baltimore & Ohio.
A. D. Schermerhorn, Division Engineer, Union Pacific.

XIV—Committee on Yards and Terminals.

F. S. Stevens (Chairman), Superintendent Philadelphia & Reading.
E. E. R. Tratman (Vice-Chairman), Resident Editor, Engineering News.
Hadley Baldwin, Superintendent, Cleveland, Cincinnati, Chicago & St. Louis.
W. C. Barrett, Division Engineer, Baltimore & Ohio.
G. H. Burgess, Chief Engineer, Delaware & Hudson Co.

L. G. Curtis, Division Engineer, Baltimore & Ohio.
A. H. Dakin, Jr., Consulting Engineer.
H. T. Douglas, Jr., Chief Engineer, Wheeling & Lake Erie.
A. C. Everham, Assistant Tunnel Engineer, Detroit River & Tunnel Co.
M. J. Henoch, Resident Engineer, Louisville & Nashville.
H. A. Lane, Assistant Engineer, Baltimore & Ohio.
E. J. McIntyre, Assistant Engineer, Northern Pacific.
B. H. Mann, Signal Engineer, Missouri Pacific.
A. Montzheimer, Chief Engineer, Elgin, Joliet & Eastern.
G. F. Morse, Assistant Engineer, Central of New Jersey.
C. C. Post, Jr., Assistant Engineer, Union Pacific.
C. H. Spencer, Engineer, Washington Terminal Company.
C. H. Stein, Engineer Maintenance of Way, Central of New Jersey.
A. Swartz, Division Engineer, Erie.
E. B. Temple, Assistant Chief Engineer, Pennsylvania.

XV—Committee on Iron and Steel Structures.

C. H. Cartlidge (Chairman), Bridge Engineer, Chicago, Burlington & Quincy.
A. J. Himes (Vice-Chairman), Engineer Grade Elimination, New York, Chicago & St. Louis.
J. C. Bohland, Bridge Engineer, Great Northern.
Charles Chandler, Bridge Engineer, Chicago Great Western.
C. L. Crandall, Professor Railway Engineering, Cornell University.
J. E. Greiner, Consulting Engineer.
B. W. Guppy, Bridge Engineer, Boston & Maine.
Charles M. Mills, Consulting Engineer.
C. Monsarratt, Chief Engineer of Bridges, Canadian Pacific.
C. D. Purdon, Missouri Pacific.
A. R. Raymer, Assistant Chief Engineer, Pittsburg & Lake Erie.
A. F. Robinson, Bridge Engineer, Santa Fe.
C. C. Schneider, Consulting Engineer.
I. F. Stern, Engineer of Bridges, Chicago & Northwestern.
F. E. Turneaure, Dean, College of Engineering, University of Wisconsin.
J. R. Worcester, Consulting Engineer.

XVI—Committee on Economics of Railway Location.

A. K. Shurtleff (Chairman), Office Engineer, Chicago, Rock Island & Pacific.
A. C. Dennis (Vice-Chairman), Assistant Engineer, Canadian Pacific.
C. Frank Allen, Professor Railroad Engineering, Massachusetts Institute Technology.
R. N. Begien, Division Engineer, Baltimore & Ohio.
Willard Beahan, Assistant Engineer, Lake Shore & Michigan Southern.
C. P. Howard, Lake Shore & Michigan Southern.
P. M. LaBach, Assistant Engineer, Missouri Pacific.
L. B. Merriam, Consulting Engineer.
C. J. Parker, Principal Assistant Engineer, New York Central & Hudson River.
J. E. Schwitzer, Assistant Chief Engineer, Canadian Pacific.
Francis Lee Stuart, Chief Engineer, Erie.
Walter Loring Webb, Consulting Engineer.

XVII—Committee on Wood Preservation.

W. K. Hatt (Chairman), Professor Civil Engineering, Purdue University.
W. H. Courtenay (Vice-Chairman), Chief Engineer, Louisville & Nashville.
E. H. Bowser, Chief Timber Inspector, Illinois Central.
Walter Buehler, Consulting Engineer, Kettle River Quarries Company.
Lincoln Bush, Consulting Engineer.
O. Chanute, Consulting Engineer.
C. K. Conrad, Assistant Engineer, Erie.
E. B. Cushing, Engineer of Construction, Sunset Central Lines.
G. M. Davidson, Chemist, Chicago & Northwestern.
E. O. Faulkner, Manager Tie and Timber Department, Santa Fe.
V. K. Hendricks, Assistant Engineer Maintenance of Way, St. Louis & San Francisco.
A. L. Kuehan, General Superintendent, American Creosoting Company.
S. M. Rowe, Consulting Engineer.
E. A. Sterling, Forester, Pennsylvania.
Earl Stimson, Chief Engineer Maintenance of Way, Baltimore & Ohio Southwestern.
Herrmann Von Schrenk, Supervisor of Timber Preservation, Rock Island, Frisco and Chicago & Eastern Illinois.
Howard F. Wiss, Forest Service, United States Department of Agriculture.

XVIII—Committee on Electricity.

George W. Kittredge (Chairman), Chief Engineer, New York Central & Hudson River.
J. B. Austin, Jr. (Vice-Chairman), Engineer Maintenance of Way, Long Island.
R. D. Coombs, Consulting Engineer.
A. O. Cunningham, Chief Engineer, Wabash.
E. P. Dawley, Consulting Engineer.
G. A. Harwood, Chief Engineer, Electric Zone Improvements, New York Central & Hudson River.
W. W. Drinker, Assistant Engineer, Erie.
W. S. Kinnear, Assistant General Manager, Michigan Central.
C. E. Lindsay, Division Engineer, New York Central & Hudson River.
E. H. McHenry, Vice-President, New York, New Haven & Hartford.
J. A. Peabody, Signal Engineer, Chicago & Northwestern.

Special Committee on Uniform General Contract Forms.

J. C. Irwin Chairman), Chief Engineer, Rutland.
W. G. Brimson (Vice-Chairman), Vice-President and General Manager, Quincy, Omaha & Kansas City.
E. F. Ackerman, Assistant Engineer, Lehigh Valley.
F. H. Alfred, Assistant to President, Cincinnati, Hamilton & Dayton.
William Archer, Assistant Engineer Maintenance of Way, Baltimore & Ohio Southwestern.
William Ashton, Chief Engineer, Oregon Short Line
W. L. Breckinridge, Engineer Maintenance of Way, Chicago, Burlington & Quincy.
E. H. Lee, Chief Engineer, Chicago & Western Indiana.
F. W. Smith, Engineer of Construction, Cleveland, Cincinnati, Chicago & St. Louis.
W. F. Tye, Civil Engineer.
C. A. Wilson, Consulting Engineer.

Special Committee on Brine Drippings From Refrigerator Cars.

J. C. Mock (Chairman), Electrical Engineer, Detroit River Tunnel Company (Representing Committee on Signals and Interlocking.)
C. H. Cartlidge, Bridge Engineer, Chicago, Burlington & Quincy. (Representing Committee on Iron and Steel Structures.)
C. B. Hoyt, Superintendent Track Maintenance and Construction, New York, Chicago & St. Louis. (Representing Committee on Track.)

Special Committee Co-Operating with National Conservation Commission.

A. S. Baldwin (Chairman), Chief Engineer, Illinois Central.
D. W. Lum (Vice-Chairman), Chief Engineer Maintenance of Way and Structures, Southern.
Moses Burpee, Chief Engineer, Bangor & Aroostook.
W. A. Bostwick, Metallurgical Engineer, Carnegie Steel Company.
E. B. Cushing, Engineer of Construction, Sunset Central Lines.
E. O. Faulkner, Manager Tie and Timber Department, Atchison, Topeka & Santa Fe.
A. L. Kuehn, General Superintendent, American Creosoting Company.
C. L. Ransom, Resident Engineer, Chicago & Northwestern.

Special Committee Co-Operating with National Advisory Board on Fuels and Structural Materials.

Hunter McDonald, Chief Engineer, Nashville, Chattanooga & St. Louis.
Howard G. Kelley, Chief Engineer, Grand Trunk.
Julius Kruttschnitt, Director of Maintenance and Operation, Harriman Lines.

STANDARD SPECIFICATIONS FOR CEMENT.*

By an oversight this special committee made its last report through the masonry committee, which, prior to 1904, had handled the matter of standard specifications for cement. Since the report of 1905, when the present standard specifications for cement were adopted, the special committee has not reported, as there was nothing particular to report. However, during the last two years the committee of the American Society for Testing Materials and representatives of other societies and associations co-operating with it have been active in considering a revision of the standard specifications for cement.

At a meeting on June 30, 1909, at Atlantic City, certain amendments to the standard specifications for cement were

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

recommended by the committee. These amendments were favorably received by the American Society for Testing Materials and were later approved by letter-ballot.

To bring M. of W. specifications up to date and put them in line with the new standard of the American Society for Testing Materials it will be necessary to amend paragraph 15, under Natural Cement, page 102 of the 1907 edition of the Manual, to read as follows:

"The minimum requirements for tensile strength for briquettes one inch square in cross-section shall be as follows, and shall show no retrogression in strength within the periods specified:

Age Neat Cement.	Strength.
24 hours in moist air	75 lbs.
7 days (1 day in moist air, 6 days in water)	150 lbs.
28 days (1 day in moist air, 27 days in water)	250 lbs.
One part cement, three parts standard Ottawa sand:	
7 days (1 day in moist air, 6 days in water)	50 lbs.
28 days (1 day in moist air, 27 days in water)	125 lbs.

Paragraph 19, under Portland Cement, page 103, should be made to read:

"The specific gravity of cement shall not be less than 3.10. Should the tests of cement as received fall below this requirement, a second test may be made upon a sample ignited at a low red heat. The loss in weight of the ignited cement shall not exceed 4 per cent."

HOWARD G. KELLEY,
Chairman of Committee on Standard Specifications for Cement.

Paragraph 22, under Portland Cement, same page, should be revised to read:

"The minimum requirements for tensile strength for briquettes one inch square in section shall be as follows, and the cement shall show no retrogression in strength within the periods specified:

Age Neat Cement.	Strength.
24 hours in moist air	175 lbs.
7 days (1 day in moist air, 6 days in water)	500 lbs.
28 days (1 day in moist air, 27 days in water)	600 lbs.
One part cement, three parts standard Ottawa sand:	
7 days (1 day in moist air, 6 days in water)	200 lbs.
28 days (1 day in moist air, 27 days in water)	275 lbs.

Conclusions.

It is recommended that the standard specifications for cement be revised to conform with the amendments reported.

As standard specifications for cement have always been reported by the masonry committee, the special committee recommends that this practice be continued and that the masonry committee be instructed to incorporate the revisions to the standard specifications for cement in its report and that the revised specifications appear in the Manual as a part of the masonry committee report; and as the masonry committee formerly handled the question of standard specifications for cement, which work is naturally a part of the work of the masonry committee, the special committee further recommends that this work be reassigned to the masonry committee and that the special committee be dismissed.

The report is signed by: Howard G. Kelley (Grand Trunk), chairman; C. W. Boynton (Univ. Port. Cem. Co.) and C. H. Moore (Erie).

WOOD PRESERVATION.*

The instructions to the committee were:

(1) Consider revision of Manual; if no changes are recommended, make statement accordingly.

(2) Continue compilation of statistics, conferring with Committees III, on Ties, and VII, on Wooden Bridges and Trestles.

(3) Continue investigation of proper grouping of different timber for antiseptic treatment.

(4) Report on the proper preparation of timber for treatment, giving consideration to the deterioration of wood while undergoing air seasoning, and its handling prior to the injection of antiseptics.

(5) Report on the proper quantity and quality of antiseptics to be used for preservation, and determine the conditions under which they should be used. The most successful antiseptics should be first considered and attention drawn to those which have failed and give no promise of success. (Crude petroleum can be discussed under this head.)

(6) Investigate and report on tests of strength of treated timber showing effect of antiseptics on its strength.

The following sub-committees were appointed:

A—Revision of Manual and Specifications for New Processes: W. H. Courtenay, chairman; R. N. Begien, Carl G. Crawford, W. W. Curtis, E. O. Faulkner, E. B. Cushing.

W. K. HATT,
Chairman of Committee on Wood Preservation.

B—Statistics and Inspection: O. Chanute, chairman; C. K. Conrad, V. K. Hendricks, S. M. Rowe, Hermann von Schrenk, Howard F. Weiss.

C—Grouping of Different Timbers, Fungi, Seasoning: Howard F. Weiss, chairman; Hermann von Schrenk, A. L. Kuehn.

D—Crude Petroleum, Wood Creosote and Petroleum Tar Oil: G. M. Davidson, chairman; Carl G. Crawford, W. W. Curtis, E. O. Faulkner.

E—Strength of Treated Timber: V. K. Hendricks, chairman; Earl Stimson, Lincoln Bush.

F—Instructions for Inspection of Treatment of Timber: A. L. Kuehn, chairman; R. N. Begien, E. H. Bowser, G. M. Davidson.

Revision of Manual.

The matter in the Manual at present consists of specifications for:

(a) Analysis of Coal-Tar Creosote.

(b) Determination of Zinc in Treated Timbers—Bulletin 103, September, 1908—Addenda to Manual of 1907. The committee recommends no change except textual improvements that in no wise alter the substance.

(c) Recommended Standard Specifications for Tie Treatment—Manual of 1907, pp. 48-53. The committee recommends changes in these specifications that reflect the trend of practice toward air-seasoning and more careful grouping of ties for treatment and better inspection.

(d) The committee recommends no change in the specifications for coal-tar creosote, adopted in 1909, for insertion in the Manual.

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

(e) Recommended Practice (adopted Vol. 10, 1909, Part 1, p. 630)—The committee recommends the following change:

(3) Preserved wood may be destroyed by mechanical wear before it is decayed, and therefore should be protected by economical devices when the mechanical life limits the life of the tie.

The following paragraphs embody the more important changes and additions to the specifications for tie treatment:

Ties shall not be treated until air-seasoned. If they arrive at the treating plant in a seasoned condition, ready to treat, they may be loaded direct from the cars to the tram buggies; otherwise they shall be piled on the ground in their respective groups or classes, green ties separated from partially seasoned or from seasoned ties, and all resting on treated stringers, with not less than 6 inches air space between bottom of lowest tier and ground; the spaces under, between and around the piles shall be thoroughly drained, and at all times kept clear of weeds, high grass and decaying matter. The top tier shall be laid sloping to form a watershed. Especial attention should be given to keeping all rotten wood off of the yard and away from the ties. Ties shall be piled either 8x1 or 8x2 or any other manner adapted to secure rapid and uniform seasoning with mimimum checking. Alleys must be left between piles, with 4 feet clear space in one direction and 1 foot in the other direction. These alleys will, in general, provide for uniform and fairly rapid seasoning.

Since the seasoning varies with the latitude, time of year, the exposure and peculiarities of the season, it is best to establish by experiment the weight per cubic foot at which each class of timber will best receive the treatment, and then to weigh from time to time to determine when the timber is ready for treatment. Ties piled for seasoning shall be closely watched, and not allowed to over-season or to deteriorate.

When ties that are not seasoned must be treated, and are to be treated with creosote, either long steaming or seasoning in hot creosote oil within safe limits of heat, as determined by experience, may be resorted to.

Under plain creosoting, the proposed specifications provide that the dead oil be heated to a temperature of not less than 160 deg. before admission to the cylinder. The old specification places the minimum at 140 deg.

The following three paragraphs are added to the specifications for plain creosoting:

This [calculated amount of oil absorbed] should be checked occasionally by weighing the ties loaded on the cylinder tram cars before and after treatment, a scale being inserted in the tram racks.

Daily reports of the injections shall be made. At least once a week an account of stock shall be taken and balance established to check the reported amounts used.

In making all measurements the oil should be at a constant temperature, or they should be reduced to a constant temperature by a proper reduction factor.

The specifications for Wellhouse treatment are omitted.

The specifications for zinc-creosote emulsion treatment are entirely new, as follows:

An emulsion of zinc-chloride and suitable coal-tar (creosote), the latter being at least 10 per cent of the whole, shall be admitted. Adequate pressure shall be applied and maintained until the desired absorption is obtained. The amount of solution injected shall be such as to leave in the wood an equivalent of 4-10 pound of dry soluble zinc-chloride and from 1¼ to 1½ pounds of creosote per cubic foot on the average.

The zinc-chloride used shall be as weak as can be used and still obtain the desired absorption of zinc-chloride, and shall not be stronger than 3½ per cent. It shall be as free from impurities as is practicable, free from free acid and containing not more than 25/1000 of 1 per cent of iron. The coal-tar oil used shall be as nearly as possible of the same specific gravity as the zinc-chloride solution. It should generally conform to the standard specifications for coal-tar creosote of this association, except that it should preferably contain a large percentage of tar acids and a small percentage of naphthalene. To insure as perfect a mixture of the emulsion of the zinc-chloride solution with the coal-tar oil as possible, an effective stirring apparatus must be used in the storage tank, and preferably also in the cylinder. The emulsion shall be heated to a temperature of not less than 140 deg. F. before admission to the cylinder, and if the latter is provided with steam coils, pressure shall be maintained in these coils during treatments. Hydraulic pressure of 100 pounds per square inch shall be applied upon the emulsion in the cylinder and shall be maintained until the required amounts are injected as above specified. The amount absorbed shall be determined by calculations based upon gage readings, both before the introduction of the emulsion into the cylinder and after forcing it back after treatment. This should be checked occasionally by weighing the ties loaded on the cylinder tram cars, before and after treatment, a scale being inserted in tram tracks. Daily reports of the injections shall be made, and at least once a week an account of stock shall be taken and balance established to check the reported amounts used. In making all measurements the oil should be at a constant temperature, or the measurements should be reduced to a constant temperature by a proper reduction factor.

The committee recommends for insertion in the Manual the specification for analysis of coal-tar creosote, adopted in 1908 (Vol. 9, 1908, pp. 708-711, 768).

The following additions to the rules for the determination of zinc in treated timbers (adopted in 1908, Vol. 9, pp. 712-714, 768) are recommended for printing in the Manual:

All chemicals used should be tested for purity from time to time. Either the chemists for the company will do this themselves or indicate some simple tests which may be applied by operatives at the works.

In operating with zinc-chloride, the strength of the solution should be varied from time to time to conform to the kind and condition of the ties, so as to inject the required quantities. But in no case shall the strength of the solution exceed 5.0 per cent.

It is better to inject quantities of the chemicals in excess of the requirements than to skimp the treatment in any way.

Daily reports should be kept at the works, and duplicates sent to the general office, if desired, in order to check the operations.

Ties treated with zinc-chloride should dry for some little time (to harden the outer surface) before they are put in the tracks. This is preferably done in piles, arranged to induce drying without checking as evaporation takes place.

Dating nails should be inserted in the ties and an account kept of the average lives obtained, in order to be able hereafter to improve on the treatment.

Statistics and Inspection.

The sub-committee on statistics has been able to add very little to the data published last year in Table 1. It has not yet obtained reliable information as to some ancient experiments, and most of those made since 1903-4-5-6 are too recent to furnish absolute conclusions. The sub-committee has, however, been made aware that great differences are found in the life of zinc-treated ties in the track. On some roads they promise to average 14 to 17 years, while on others they are giving out in five to six years. This is fully confirmed by the results of the recent examination (Appendix C) of the experimental track on the Gulf, Colorado & Santa Fe of treated ties laid from February to May, 1902. It cannot be too strongly pointed out that no adequate results will be obtained with any process unless the work is skillfully and honestly done.

The sub-committee was instructed to begin the following new work:

(a) Importation, production and consumption of creosote and zinc chloride.

(b) Amount and kind of timber treated.

On the above matters the sub-committee submits statistics from government and other reports.

(c) Methods of treatment.

Only two preservatives are being used in practice, i. e., creosote and chloride of zinc. Creosoted ties which have heretofore given good results were treated by the "full cell" process, with 10 to 20 pounds per cubic foot.

(d) Consider the question of economics of timber preservative. The sub-committee is not yet prepared to report on this question. It wants more data.

(e) Confer with other committees. This has been done.

(f) Inspect and report on the Texas, the Northern Pacific, the Chicago & North Western and other service tests.

The sub-committee has a copy of the inspection report of the experimental track laid by the Chicago & North Western in July, 1907. The conclusion of the examiners was that: "At the end of one year and eight months' service all of the ties were in a perfect state of preservation. There was no noticeable difference in the soundness of the treated and untreated ties."

The Northern Pacific laid test tracks near Maywood, Wash., in the late fall of 1906, and in western Montana, near Plains, in 1907. This track has not been in service long enough to furnish conclusions.

The report on the Texas experimental track is the most interesting and valuable thus far received. It is given in full in Appendix C.

Grouping, Fungi, Seasoning.

H. D. Tiemann, of the Forest Service, stationed at the Yale Forest School, has made a careful and original examination of wood structure and how fluids enter wood. His report, printed in full in Appendix E, shows that air seasoning, or, to a less effective degree, steaming, is necessary to open slits in the walls of the cells of wood which otherwise are impenetrable to fluids under pressure. He observes that the slits or openings that permit entrance of fluids to the cells begin when the moisture in the cell walls begins to dry out. These openings, therefore, occur before the wood is completely air seasoned; for the initial drying out of the cell wall is an intermediate stage in the seasoning of wood from the green state until it ceases to lose weight. In loblolly pine, for instance, the green state may be characterized by 60 per cent. moisture, and the fiber saturation point (at which the walls begin to dry) by 25 per cent. and the complete air seasoning by 12 per cent. to 18 per cent., depending upon size and climate. The fiber saturation point varies from about 25 to 30 per cent. moisture in various species. This suggestive and interesting study should give direction to experimentation under the conditions of practical workings of preserving plants.

The proper grouping of timbers is discussed in Appendix F, by H. F. Weiss, of the Forest Service, who suggests a tentative grouping which may be used in experimental determination of the most practical working grouping to fit the local condition existing at any plant. He concludes that to obtain uniform penetration and absorption, air-seasoned ties should preferably be used, but if the ties are not fully air-seasoned, they should have equal moisture per cent. when placed in the treating cylinder.

The recorded data of air-dry weights of wood have been summarized in Appendix F. Certain hitherto unpublished results of seasoning tests of ties and English woods are presented in Appendix G.

The term "air-seasoned" does not specify a fixed degree of moisture. A board one inch thick, when air-seasoned, may not have more than 15 per cent. moisture, while a tie, air-seasoned, may have 30 per cent. Again, a board air-seasoned in California in summer may have a less moisture content than one air-seasoned in Louisiana; and a plank of pine less than a plank of oak. The moisture content of air-seasoned wood varies with size, species and atmosphere fluctuations of temperature and humidity. Furthermore, the variation of moisture in large sticks must be reckoned with.

To aid in inspection of timber, a description of the fungi that attack wood is submitted in Appendix H by C. J. Humphrey, pathologist in the Bureau of Plant Industry.

Preservatives.

Crude Petroleum—In 1902 a test track was laid on the Beaumont division of the Gulf, Colorado & Santa Fe, between Pelican, Tex., and Cleveland. Ties treated with Beaumont crude oil and Bakersfield oil containing a heavy asphaltum base were used. Those treated with the Beaumont oil were short lived and gave but little, if any, service beyond those which had not been treated. These treated ties are stated by E. O. Faulkner to have been half-seasoned, and to have absorbed only about one pound of oil per cubic foot. The ties treated with Bakersfield oil are still in the track, in a good state of preservation, which, in view of the fact of the very severe climatic conditions existing in this locality, may be considered as giving good service. The amount of oil forced into these ties varied considerably, depending on the amount of sapwood, ranging all the way from 23 to 82 pounds per tie. It is generally conceded that the oil does not possess any antiseptic value, but clogs up the cells of the wood to such an extent that moisture is unable to enter. This means that in order to preserve the tie, large quantities must be injected.

The Santa Fe has since constructed a plant to treat its ties, using crude petroleum with a heavy asphaltum base. This plant has only been in operation two years, and the ties have not been in use long enough to give results.

Wood Creosote—This oil has had a limited use as a wood preservative in the United States for more than 20 years. The only methods of application, however, have been either to paint it on with a brush or to immerse the timber in the wood creosote for a brief period of time. Very few records have been kept of its use. It is hard to foretell what the results would have been had the oil been forced in under pressure according to the most approved methods. In Europe some attempts have been made to use wood creosote oil instead of tar creosote oil. On the Swedish State Railways, experiments were begun in 1903. It was, however, difficult to get the oil to penetrate deep enough into the wood, and although a pressure of 182 pounds was employed, not more than 12 pounds to the tie could be absorbed. So far, the ties seem perfectly sound. The price of the oil used for these experiments is about 2 cents a pound.

Petroleum Tar Creosote—This product, which is distilled from the tar that results from the manufacture of water gas, has not been used in its pure state to any extent in the United States, or, if it has, it has been used under some other name. Many reports have been circulated that it has been freely used as an adulterant and mixed with coal-tar creosote; however, there is no data as to its value.

In 1906 the Forest Service conducted experiments in the treatment of mine timbers placed in the Silver Creek mine of the Philadelphia & Reading Coal and Iron Co., near Pottsville, Pa. The conditions for decay were unusually severe, the ordinary loblolly pine timber 10 inches in diameter being completely decomposed in from eight months to three years, depending on its location. Several barrels of petroleum tar creosote were obtained to use in the treatment of the experimental timber to be placed in this mine, and unusual care was taken in selecting the fractions distilled from the petroleum tar. The timbers treated with this product are in an excellent state of preservation at the present time, although located in close proximity to other timbers placed at the same time which have completely rotted away. The conditions in the mine are altogether different from those found in the open. Humidity and temperature remain practically the same; therefore the timbers do not check as they would in the open.

Strength of Treated Timber.

A synopsis of all available previously unpublished data is shown. The various tests have been made on different sized sticks, and the data is not sufficiently extensive, so that only a tentative conclusion regarding the effect of treatment can be reached at this time.

The average of the results with Douglas fir tested at the Sacramento shops of the Southern Pacific and at the University of California indicates a decrease of the modulus of elasticity of some 10 or 15 per cent. for the creosoted timber, as compared with untreated timber, and a decrease of some 30 per cent. in the outer stress at elastic limit and at failure.

This creosoted timber, however, was treated by the boiling process, and the records of treatment were destroyed in the San Francisco fire of April, 1906, so that the details of treatment are not available. It is probable that the heating by the boiling process may have been responsible for the weakening of the timber, or it may be that the characteristics of the Douglas fir timber are such that it will be weakened by treatment. Sticks 4 in. x 6 in. in cross-section were cut from the interior of the large sticks where the creosote had not penetrated, and these showed about one-half the strength of untreated sticks of similar size. It is possible that the temperatures formerly used were in excess of those of present practice. Further tests are necessary, and such tests are under way at Seattle, Wash., under direction of the Forest Service.

The tests of longleaf yellow pine show little, if any, reduction in outer fiber stress at failure for creosoted bridge stringers as compared with the natural wood. These tests cover 10 beams of treated and 10 untreated in each case, representing carefully selected material, well matched, and with the full history of treatment, etc., known.

These tests showed that the difference between the strength of the top end and the bottom end of the 32-foot stringer may be anywhere from 8 to 0 per cent. and this difference between the butt and top should, therefore, be considered in drawing conclusions from the tests.

The tests of loblolly pine at Purdue University, in connection with the tests of longleaf yellow pine mentioned above, showed a loss in strength of the loblolly pine in flexure of about 16 per cent., and in compression perpendicular to the grain about 29 per cent.

Tests by Professor Talbot on loblolly pine beams show, in Series C, a reduction of 44 per cent. in elastic limit and 30 per cent. at maximum load, but in Series D a greater strength when treated is shown, the latter result being corroborated by the results of tests of small test beams taken from the uninjured portion of the beams of Series D. In Series N, in which the alternative sticks were creosoted, the treated timber gave 17 per cent. less strength at elas-

tic limit, and 22 per cent. less strength at maximum load than the untreated timber. The strength of the treated shear blocks in Series N was 11 per cent. less than that of the untreated blocks.

In unpublished tests which were made some time ago at the University of Illinois, on oak and gum ties, the half length of each tie being treated and the other half being untreated, the modulus of rupture, elastic limit and shearing strength are stated by Professor Talbot to have been from 5 to 10 per cent. less than the values of the untreated ties.

The indications from certain minor tests are that creosoting has little effect on the strength of Douglas fir or Wisconsin white pine in tension or end compression; but does weaken it some 20 to 25 per cent. in shear. Burnettizing appears to weaken the timber, but the Burnettized specimens were not so dry as the untreated. It may be noted that the cellulose is soluble in a 40 per cent. solution of zinc chloride.

The conclusions to be reached from Forest Service Circular 309, Experiments on the Strength of Treated Timber, are fairly well based, and are as follows:

That wood treated with zinc chloride at a temperature of about 250 deg. F. renders the timber brittle. It is possible this may be on account of free acid in the solution, but this question will require further investigation before it can be determined; that the creosote itself is largely inert, and has its chief influence in modifying the transmission of moisture in or out of the wood; that excessive steam pressures are detrimental to the timber—anything over four hours at 30 pounds, or six hours at 20 pounds, exceeding the safe limits.

In Dr. Hatt's Fourth Progress Report of Tests of Treated Ties the tests showed very little diminution in strength in rail bearing for either creosoted or Burnettized red oak or creosoted loblolly pine ties as compared with the untreated timber. The lateral and pulling resistance of the spikes did not appear to be affected much, if any, by treatment of the timber, except in the case of crude oil. The crude oil was unusually viscous and a temperature of 210 deg. F. was used. The extremes of atmospheric temperature are found to have an appreciable effect on the strength of wood, especially when green. The warm timber is from 9 to 17 per cent. weaker than the very cold timber.

The committee calls attention to the data that should accompany any report on the strength of treated wood. In so many cases the results are entirely accidental, and the variation in strength introduced by the elements other than the treatment will entirely mask the latter. The reports should be examined with reference to the following elements at least: description of wood with reference to heart, sap and openness of grain; condition of seasoning; details of treatment, including analysis of preservative, with steam pressure, if any, temperature of oil or preservative; length of time between treatment and test, and exposure during this time; origin of test pieces to eliminate difference of strength between butt and top of long sticks. Again, in quoting the conclusions, the particular exhibition of strength should be considered. For instance, very wet wood, and probably wood heavily dosed with creosote, will show greater weakness under side compression than under flexure or end compression. Then, too, it must be clearly distinguished whether small pieces of timber are treated or large pieces, because the artificial seasoning under the high temperatures of the cylinder will introduce internal strains that result in serious checks, when large timbers are treated. This weakness is more likely to appear in tests of the material under shear or in ruptures of large beams under longitudinal shear. It is probable that this accounts for some of the deficiencies in strength reported.

The data so far obtained appears to support the following conclusions:

(1) With reference to small material, such as ties:
 (a) High steaming will diminish the strength rapidly.
 (b) Treating with strong solution of zinc chloride will render the timber brittle, perhaps because of free acid in the solution.
 (c) Creosote is inert.
 (d) Seasoned timber treated with light doses of creosote is as strong as the original timber.

(2) With reference to large bridge material:
 (a) The use of high steam pressures of 40 to 50 pounds is attended with considerable loss of strength.
 (b) The thermal condition of the treatment introduces internal strains that result in internal checks, which, in turn, weakens the timber to shearing stresses.
 (c) Heavily creosoted material is weak in compression at right angles to the grain.

(3) Treatment with crude petroleum may render wood soft and weak, at least temporarily; it is to be determined whether this is the effect of the process or of the preservative.

Recommendations for Future Work.

The extension of the table of statistics and the gathering of information concerning the life and use of treated timber should be continued. Further investigation and report should be made on the use and value of other preservatives, particularly crude petroleum and petroleum tar oil.

The committee should, in the next report, extend the revision of specifications for timber treatment, to include the Rueping, Lowry and other widely used processes, both for ties and timber. The specifications should be in the form of general requirements for handling of the wood previous to treatment, and detailed specifications covering all the processes in general use. There should also be submitted, in connection with these, the standard forms of inspection report blanks for various treatments.

Experiments to show proper grouping and seasoning of wood should be inaugurated at treating plants. The facilities soon to be available at the Forest Products Laboratory of the Forest Service, Madison, Wis., involving an experimental cylinder and all accessories, should result in valuable and useful data.

The question of track fastenings to be used with treated ties is one of economics, depending in part upon the life of a treated tie against decay and its life against mechanical wear. The determination for suitable fastenings should be made a subject of joint consideration of the proper committees for future work.

Conclusions.

1. That the changes in the specifications for tie treatment embodied in this report be adopted and placed in the Manual.

2. That the new version of Conclusion No. 3 of Recommended Practice be adopted and placed in the Manual.

3. That additions to Recommended Practice given in the report be adopted and placed in the Manual.

The report is signed by: W. K. Hatt (Purdue Univ.), Chairman; W. H. Courtenay (L. & N.), Vice-Chairman; R. N. Begien (B. & O.), Lincoln Bush (Consulting Engineer), O. Chanute (Consulting Engineer), C. K. Conard (Erie), C. G. Crawford (Amer. Creosoting Co.), E. B. Cushing (Sunset Central Lines), G. M. Davidson (C. & N. W.), V. K. Hendricks (St. L. & S. F.), R. L. Huntley (U. P.), A. L. Kuehn (Amer. Creosoting Co.), S. M. Rowe (Consulting Engineer), Earl Stimson (B. & O. S. W.) and Howard F. Weiss (Forest Service).

BALLAST.*

The following sub-committees were appointed:

Revision of Stone Ballast Specifications in the Manual: S. N. Williams, Chairman; J. B. Dickson, R. D. Starbuck.

Method of Making Physical Tests of Stone Ballast: S. A. Jordan, Chairman; H. E. Hale, H. B. Dick, J. G. Bloom.

Proper Thickness of Ballast, Distribution of Load on Roadbed and Question of Sub-Ballast: C. A. Paquette, chairman; H. E. Hale, G. D. Hicks, J. M. Meade, C. C. Hill.

Review of Report on Gravel Ballast and Methods of Grading Qualities: F. J. Stimson, Chairman; C. A. Paquette, W. J. Bergen, O. P. Allee.

Treatment of Foul Ballast: F. J. Bachelder, Chairman; C. S. Millard, G. M. Walker, Jr.

Mr. Jordan being unable to serve on his sub-committee, H. E. Hale was, a little later, appointed chairman in his stead.

The committee recommends that the definitions of sand and gravel as amended last year be printed in the Manual in the place of those first inserted.

The sub-committee on revision of stone ballast specifications has reported as follows:

Ballast should be of such character as to transmit the

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

pressure to and distribute it on the roadbed with minimum displacement of either, besides affording proper drainage. Sizes used should depend on the nature of the soil, kind of coal used and on the character of the traffic. One road reports that 2-in. rock will fill to the top of the tie in twelve years, then when cleaned to the depth of the tie will fill again in about six years. Another line advises using a less shoulder than usual to avoid poor drainage and finds 4 in. on straight track and 6 in. on curves satisfactory, since the sharp edges offer much friction and little rock keeps the track in line. The small broken rock keeps a finer surface, can readily be handled and allows a slight adjustment of grade, while a large size requires a corresponding raise. Too fine rock may foul easily and prevent quick drainage, does not hold line and surface as well as coarse rock, but this does not make as compact a mass and may work down into a bad soil. There is apt to be much dust with smaller sizes, while large sizes are not apt to have as sharp angles and not hold the ties as well. Light traffic has less tendency to pulverize the rock and requires less tamping, while heavy traffic requires larger dimensions. One road reports it costs about 25 per cent. more to apply 3-in. rock than 1½-in., and another that it

JOHN V. HANNA,
Chairman of Committee on Ballast.

costs more to maintain. The quality, however, decides the size used. In preparing specifications a rock of desired quality should be selected and the specifications prepared for this particular rock or that of a corresponding quality. Granite, slag and some gravel can be used to any degree of fineness, since they do not silt up and allow free drainage:

In Appendix A abstracts of replies to the committee's circular of inquiry are given.

The sub-committee recommends that the ballast specifications be revised to read:

Revised Specifications for Rock Ballast.

1. Rock ballast shall be sufficiently durable not to disintegrate in the climate where used; hard enough to prevent pulverizing unduly under the action of tools or traffic, and shall break with an angular fracture when crushed.

2. The maximum size shall not exceed pieces which will pass through a 2½-in. test ring in any direction.

The minimum size shall not pass through a ¾-in. test ring, and the rock shall be free from dust, dirt or rubbish.

The sub-committee refers to the physical tests adopted by the United States Government as given by the sub-committee on method of making physical tests, and to the following Pennsylvania Railroad specifications for crushing strength of standard rocks:

"Trap rock, and other rocks in that class, must withstand a crushing stress of not less than 12,000 lbs. per sq. in.; and limestone and other stone in that class must withstand a crushing stress of not less than 10,000 lbs. per sq. in.; and all other stone must pass such other tests as the railway company may from time to time think necessary to apply."

The previous report of the committee on ballast devoted considerable space to methods of preparation and delivery of ballast, particularly crushed rock, washed and pit gravel, cementing gravel, burnt clay and chats. There was also a review of the advantages and disadvantages of various types of ballast, which led to some investigation by the committee of the proportions of sand and gravel giving best results in track. The committee made some recommendations as to best proportions of these two materials for ballast under various classes of traffic. The recommendation was not adopted by the convention, but, instead, was referred back to the committee for further investigation and report. The sub-committee appointed to consider this subject finds that there is quite a wide variance of opinion in regard to the percentages of gravel and sand which make good ballast. There are two reasons for this. First: the difference in meaning with which the term "percentage" is used. Second: the difference in the proportions of different sizes of stone of which the gravel consists.

Some engineers use the term "percentage" to indicate that portion of the original bulk which is gravel or sand. Others use it to indicate that portion of the algebraical sum of the constituent parts which is gravel or sand. Still others use it to indicate the relation of the bulk of sand to the bulk of gravel, which is considered 100 per cent.

The first and last use of the term may result in the same percentage; for instance, when the sand is not in sufficient quantity to fill the voids in the gravel. In such a case when the sand is separated from the gravel it will be found that the bulk of gravel is as great as the original bulk, making the gravel 100 per cent. and the sand the same percentage of the original bulk as of the screened gravel.

In the second use of the term the result always differs from the other two, as when 10 parts of gravel and 3 parts of sand are combined and the gravel is found to be 77 per cent. and the sand 23 per cent. of the sum of the constituent parts. In this case the actual percentage of each—of the bulk—resulting from combining the two ingredients physically, will be approximately: Gravel, 95 per cent. Sand, 28½ per cent.

In the specifications given below, "percentage" is used with the first meaning mentioned, sand if 30 per cent. of sand is designated, it means that of the original bulk, or of the bulk after combining physically the gravel and sand, 30 per cent is sand. The percentage of gravel will be 100 per cent. or less, but never as low as 70 per cent., owing to the fact that the voids in the gravel must first be filled by the sand before the bulk can be increased.

As suggested in the last paragraph, the second cause for a divergence of opinion as to the proper percentage results from the difference in the voids found in different samples of gravel. For this reason and the fact that theoretically perfect proportions call for just sufficient sand to fill the voids, there can be no fixed maximum or minimum percentage. Proportions that will result in a good ballast in one case will result in comparatively poor ballast in another. From the replies which have been received to our inquiries it is shown that 10 parts gravel and 3 parts sand represent the average practice. Especial attention is called to the fact that in the specifications two conditions are covered: (1) Bank gravel; (2) washed or screened gravel.

The committee submits the following specifications:

"For Class A Roads: When bank gravel contains more than 2 per cent. of dust or 40 per cent. of sand, it should be washed or screened. Washed or screened gravel should contain not less than 25 per cent. nor more than 35 per cent. sand.

"For Class B Roads: When bank gravel contains more than 3 per cent. of dust or 60 per cent. of sand, it should be screened or washed. Screened or washed gravel should not contain less than 25 per cent. nor more than 50 per cent. of sand.

"For Class C Roads: Any material which makes better track than the natural roadbed may be economically used."

The sub-committee on proper thickness of ballast, etc., has been unable to get its matter in shape to present. If this cannot be done in time for the convention, the work will be carried over to the coming year.

The sub-committee on physical tests of stone ballast has reported as follows:

The only physical tests of crushed stone reported which are considered reliable and have been in use for a sufficient length of time to provide a good comparison with various kinds of stone are the tests made by the Office of Public Roads, United States Department of Agriculture, at

Washington, D. C. These tests are made by the government free of charge, and were originally intended to test crushed stone for public wagon roads. These government tests for crushed stone for wagon roads, however, appeal to the sub-committee as being satisfactory physical tests for crushed stone ballast.

The tests and data given by the government are shown on form 28 of the Department of Agriculture, a copy of which is shown in Appendix A, and are as follows: (a) Weight in lbs. per cubic foot. (b) Specific gravity. (c) Water absorption in lbs. per cubic foot. (d) Per cent. of wear. (e) French coefficient of wear. (f) Hardness. (g) Toughness. (h) Cementing value.

The machine used to make the abrasion tests, or tests for wear, consists of a cast-iron cylinder closed at one end and furnished with a tightly fitting iron cover at the other end. This cylinder is 7⅞ in. in diameter and is mounted on a shaft diagonally at an angle of 30 degrees with the axis of rotation. Eleven lbs. of broken stone 1¼ in. and ½ in. in size, 50 pieces, if possible, are placed in the iron cylinder and this cylinder is revolved at 30 to 33 revolutions per minute for 10,000 revolutions for each test. The stone is then thoroughly washed and dried and the percentage of dust or detritus by weight that will pass through a screen with 1-16-in. mesh is considered the percentage of wear.

By hardness is meant the resistance of a rock to the grinding action of an abrasive agent like sand.

By toughness is meant the resistance a rock offers to fracture under impact.

By cementing value is meant the binding power of a road material or dust from rocks. Some rock dust possesses the quality of packing to a smooth surface of considerable tenacity and which is impervious to water, while others entirely lack this quality. The test consists of pulverizing the rock and, with water, making a paste, which is pressed into briquettes. These are dried and then tested for resiliency. Rock with the lowest cementing value (other properties being equal) is considered the best for crushed stone ballast.

Tests Recommended.

It is recommended that the tests made by the Department of Agriculture be used for physical tests of stone ballast, with the exception of those for specific gravity and the French coefficient of wear, as practically the same information is given in the other tests.

Detailed information as to how to select and ship specimens of rock to the Department of Agriculture for tests can be obtained from A. S. Cushman, Acting Director, Office of Public Roads, United States Department of Agriculture, Washington, D. C.

The sub-committee on treatment of foul ballast submits the following conclusions and recommendations:

That under usual conditions no ballast, except stone or hard slag, be cleaned.

Cleaning Foul Ballast, Recommended Practice.

Clean with ballast forks.
Clean shoulder down to subgrade.
Clean between ties to bottom of ties.
Clean center ditch of double track to subgrade.
Return clean ballast.

Stone Ballast Should Be Cleaned.

In terminals, at intervals of 1 to 3 years.
Heavy traffic, coal and coke lines, at intervals of 3 to 5 years.
Light traffic lines, at intervals of 5 to 8 years.

Per Cent. of New Stone Ballast to Be Applied.

Fifteen to 25 per cent.

Conclusions.

(1) The committee recommends the adoption of the revised specifications for crushed rock, submitted by the subcommittee on that subject.

(2) The approval, by the convention, as good practice, of the proportions of sand and gravel for various classes of roads, as submitted by the sub-committee having that subject in charge.

(3) The adoption, by the convention, of the recommendations as to physical tests of stone, made by the subcommittee having that subject in charge.

(4) The approval, by the convention, as good practice, of the methods for cleaning foul ballast, recommended by the sub-committee having that subject in charge.

The report is signed by: John V. Hanna (Kan. City Term.), Chairman; C. A. Paquette (C., C., C. & St. L.), Vice-Chairman; O. P. Allee (K. C. S.), F. J. Bachelder (B. & O.), W. J. Bergen (N. Y. C. & St. L.), J. G. Bloom (C., R. I. & P.), H. B. Dick (B. & O.), J. B. Dickson (Erie), W. H. Grant (Can. Nor., Ont.), H. E. Hale (Mo. P.), G. D. Hicks (N. C. & St. L.), C. C. Hill (Mich. Cent.), S. A. Jordan (B. & O.), J. M. Meade (A., T. & S. F.), C. S. Millard (C., C., C. & St. L.), R. D. Starbuck (Mich. Cent.), F. J. Stimson, (G. R. & I.), G. M. Walker, Jr. (Kan. City Term.), S. N. Williams (Cornell).

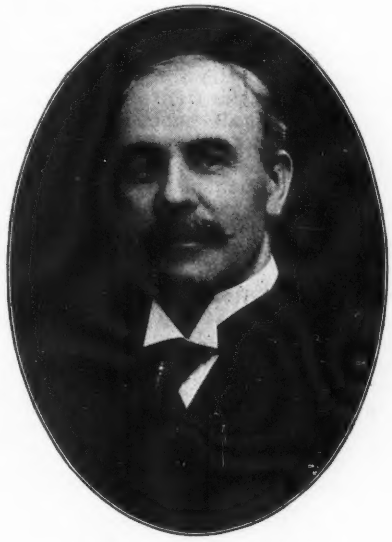
MASONRY.*

The following sub-committees were appointed:

Sub-Committee A—Specifications for Portland Cement Concrete and Reinforced Concrete: T. L. Condron, chairman; W. C. Boynton, C. H. Bartlidge, Richard L. Humphrey, A. N. Talbot, F. L. Thompson.

Sub-Committee B—Waterproofing of Masonry: G. H. Tinker, chairman; C. H. Moore, F. E. Schall, B. Douglas, L. N. Edwards.

Sub-Committee C—Monolithic Construction: W. H. Petersen, chairman; R. T. McMaster, Job Tuthill.



A. O. CUNNINGHAM,
Chairman of Committee on Masonry.

Sub-Committee D—Retaining Walls and Abutments: W. W. Colpitts, chairman; W. J. Backes, G. J. Bell.

Sub-Committee E—Reinforced Concrete Trestles, Typical Designs and Costs: G. H. Scribner, Jr., chairman; W. H. Chadbourn.

Sub-Committee F—Joint Committee on Concrete and Reinforced Concrete: A. O. Cunningham, chairman; C. W. Boynton, C. H. Moore, G. H. Scribner.

The committee reports progress on the subjects of retaining walls and abutments, monolithic construction, and reinforced concrete trestles, and requests that these subjects be reassigned.

Conclusions.

The committee recommends:

(1) That the specifications for natural and Portland cement, now appearing in the Manual, be amended to conform to the version given in the report of the special committee on standard specifications for cements (see Bulletin 118).

(2) That the specifications for Portland cement concrete now appearing in the Manual be withdrawn, and that the specifications for plain and reinforced concrete given in Appendix A of this report be adopted and incorporated in the Manual.

(3) That the recommended practice for designing reinforced concrete structures in Appendix B be adopted and incorporated in the Manual.

(4) That the report on waterproofing of masonry, in Appendix C, be received as information and the investigation continued.

The report is signed by: A. O. Cunningham (Wabash), chairman; W. H. Petersen (C., R. I. & P.), vice-chairman; W. J. Backes (Cent. New Eng.), G. J. Bell (A., T. & S. F.), C. W. Boynton (Univ. Port. Cem. Co.), C. H. Cartlidge (C., B. & Q.), T. L. Condron (consulting engineer), W. H. Chadbourn (C. G. W.), W. W. Colpitts (K. C., M. & O.), B.

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

Douglas (Detroit Riv. Tun. Co.), L. N. Edwards (Grand Trunk), Richard L. Humphrey (consulting engineer), R. T. McMaster (P. & L. E.), C. H. Moore (Erie), F. E. Schall (Lehigh Valley), G. H. Scribner, Jr. (contracting engineer), A. N. Talbot (Univ. of Ill.), F. L. Thompson (Ill. Cent.), G. H. Tinker (N. Y., C. & St. L.) and Job Tuthill (C., H. & D.).

Appendix A.

Specifications for Plain and Reinforced Concrete and Steel Reinforcement.

Concrete Materials.

1. The cement shall be Portland and shall meet the requirements of the standard specifications. (See Manual of Recommended Practice.)

2. Fine aggregate shall consist of sand, crushed stone, or gravel screenings graded from fine to coarse, and passing when dry a screen having ¼-in. diameter holes; it shall preferably be of siliceous materials, clean, coarse, free from vegetable loam or other deleterious matter, and not more than 6 per cent shall pass a sieve having 100 meshes per linear inch.

3. Mortars composed of one part Portland cement and three parts fine aggregate by weight when made into briquettes shall show a tensile strength at least equal to the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand.

4. Coarse aggregate shall consist of crushed stone or gravel, graded in size, and which is retained on a screen having ¼-in. diameter holes; it shall be clean, hard, durable and free from all deleterious material. Aggregates containing soft, flat or elongated particles shall not be used.

5. The water used in mixing concrete shall be free from oil, acid, and injurious amounts of alkalies or vegetable matter.

Steel Reinforcement.

6. Steel shall be made by the open-hearth process. Rerolled material will not be accepted.

7. Plates and shapes used for reinforcement shall be of structural steel only. Bars and wire may be of structural steel or high carbon steel.

8. The chemical and physical properties shall conform to the following limits:

Elements Considered.	Structural Steel.	High Carbon Steel.
Phosphorus, max. Basic	0.04 per cent.	0.04 per cent.
Phosphorus, max. Acid	0.06 per cent.	0.06 per cent.
Sulphur, maximum	0.05 per cent.	0.05 per cent.
Ultimate Tensile Strength.	Desired	Desired
Pounds per square inch	60,000	88,000
Elong., min. % in 8", Fig. 1	1,500,000* / Ult. tensile str'gth	1,000,000 / Ult. tensile str'gth
Character of Fracture	Silky	Silky or finely granular
Cold Bends without Fracture	180° flat†	180° $d=4t$†‡

*See paragraph 15. †See paragraphs 16 and 17. ‡"$d=4t$" signifies "around a pin whose diameter is four times the thickness of the specimen."

9. The yield point for bars and wire, as indicated by the drop of the beam, shall be not less than 60 per cent of the ultimate tensile strength.

10. If the ultimate strength varies more than 4,000 lbs. for structural steel or 6,000 lbs. for high carbon steel, a retest shall be made on the same gage, which to be acceptable, shall be within 5,000 lbs. for structural steel, or 8,000 lbs. for high carbon steel, of the desired ultimate.

11. Chemical determinations of the percentages of carbon, phosphorus, sulphur and manganese shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt of steel, and a correct copy of such analysis shall be furnished to the engineer or his inspector. Check analysis shall be made from finished material, if called for by the railway company, in which case an excess of 25 per cent above the required limits will be allowed.

12. Plates, Shapes and Bars: Specimens for tensile and bending tests for plates and shapes shall be made by cutting coupons from the finished product, which shall have both faces rolled and both edges milled to the form shown by Fig. 1. [This drawing is the same as the one in the present Manual, p. 268, illustrating test pieces for plates, shapes and bars in iron and steel structures]; or with both edges parallel; or they may be turned to a diameter of ¾-in. with enlarged ends.

13. Bars shall be tested in their finished form.

14. At least one tensile and one bending test shall be made from each melt of steel as rolled. In case steel differing ⅜ in. and more in thickness is rolled from one melt, a test shall be made from the thickest and thinnest material rolled.

15. For material less than 5-16 in. and more than ¾ in. in thickness the following modifications will be allowed in the requirements for elongation:

(a) For each 1-16 in. in thickness below 5-16 in. a deduction of 2½ will be allowed from the specified percentage.

(b) For each ⅛-in. in thickness above ¾-in., a deduction of 1 will be allowed from the specified percentage.

16. Bending tests may be made by pressure or by blows. Shapes and bars less than one inch thick shall bend as called for in paragraph 8.

17. Test specimens one inch thick and over shall bend cold 180 degrees around a pin, the diameter of which, for structural steel, is twice the thickness of the specimen, and for high carbon steel, is six times the thickness of the specimen, without fracture on the outside of the bend.

18. Finished material shall be free from injurious seams, flaws, cracks, defective edges or other defects, and have a smooth, uniform and workmanlike finish.

19. Every finished piece of steel shall have the melt number and the name of the manufacturer stamped or rolled upon it, except that bar steel and other small parts may be bundled with the above marks on an attached metal tag.

20. Material which, subsequent to the above tests at the mills, and its acceptance there, develops weak spots, brittleness, cracks or other inperfections, or is found to have injurious defects, will be rejected and shall be replaced by the manufacturer at his own cost.

21. All reinforcing steel shall be free from excessive rust, loose scale, or other coatings of any character, which would reduce or destroy the bond.

Workmanship.

22. The unit of measure shall be the cubic foot. A bag containing not less than 94 lbs. of cement shall be assumed as one cubic foot of cement. Fine and coarse aggregates shall be measured separately as loosely thrown into the measuring receptacle.

23. The fine and coarse aggregates shall be used in such relative proportions as will insure maximum density.

24. The proportions of materials for the different classes of concrete shall be as follows:

[The committee shows a blank form to be filled for each contract, the form being ruled in columns to show class, use, and proportions of cement and fine and coarse aggregates.]

25. For plain concrete, a proportion of 1:9 (unless otherwise specified) shall be used, i. e., one part of cement to a total of nine parts of fine and coarse aggregates measured separately; for example, 1 cement, 3 fine aggregate, 6 coarse aggregate.

26. For reinforced concrete a proportion of 1:6 (unless otherwise specified) shall be used, i. e., one part of cement to a total of six parts of fine and coarse aggregates measured separately.

27. The ingredients of concrete shall be thoroughly mixed to the desired consistency, and the mixing shall continue until the cement is uniformly distributed and the mass is uniform in color and homogeneous.

28. The various ingredients, including the water, shall be measured separately, and the methods of measurement shall be such as to secure the proper proportions at all times.

29. A machine mixer, preferably of the batch type, shall be used, whenever the volume of the work will justify the expense of installing the plant. The requirements demanded are that the product delivered shall be of the specified proportions and consistency and thoroughly mixed.

30. When it is necessary to mix by hand, the mixing shall be on a watertight platform of sufficient size to accommodate men and materials for the progressive and rapid mixing of at least two batches of concrete at the same time. Batches shall not exceed one-half cubic yard each. The mixing shall be done as follows: The fine aggregate shall be spread evenly upon the platform, then the cement upon the fine aggregates, and these mixed thoroughly until of an even color. The water necessary to mix a thin mortar shall then be added and the mortar spread again. The coarse aggregates, which, if dry, shall first be thoroughly wetted down, shall then be added to the mortar. The mass shall then be turned with shovels or hoes until thoroughly mixed and all of the aggregate covered with mortar. Or, at the option of the engineer, the coarse aggregate may be added before, instead of after, adding the water.

31. The materials shall be mixed wet enough to produce a concrete of such consistency that it will flow into the forms and about the metal reinforcement, and which, on the other hand, can be conveyed from the place of mixing to the forms without separation of the coarse aggregate from the mortar.

32. Retempering mortar or concrete, i. e., remixing with water after it has partially set, will not be permitted.

33. Concrete after the addition of water to the mix shall be handled rapidly from the place of mixing to the place of final deposit, and under no circumstances shall concrete be used that has partially set before final placing.

34. The concrete shall be deposited in such a manner as will prevent the separation of the ingredients and permit the most thorough compacting. It shall be compacted by working with a straight shovel or slicing tool kept moving up and down until all the ingredients have settled in their proper place and the surplus water is forced to the surface. In general, except in arch work, all concrete must be deposited in horizontal layers of uniform thickness throughout.

35. In depositing concrete under water, special care shall be exercised to prevent the cement from floating away, and to prevent the formation of laitance.

36. Before depositing concrete in forms, the forms shall be thoroughly wetted except in freezing weather, and the space to be occupied by the concrete cleared of debris.

37. Before placing new concrete on or against concrete which has set, the surface of the latter shall be roughened, thoroughly cleansed of foreign material and laitance drenched and slushed with a mortar consisting of one part Portland cement and not more than two parts fine aggregate.

38. The faces of concrete exposed to premature drying shall be kept wet for a period of at least three days.

39. The concrete shall not be mixed or deposited at a freezing temperature, unless special precautions, approved by the engineer, are taken to avoid the use of materials containing frost or covered with ice crystals, and to provide means to prevent the concrete from freezing.

40. Where the concrete is to be deposited in massive work, clean, large stones, evenly distributed, thoroughly bedded and entirely surrounded by concrete, may be used, at the option of the engineer.

41. Forms shall be substantial and unyielding and built so that the concrete shall conform to the designed dimensions and contours, and so constructed as to prevent the leakage of mortar.

42. The forms shall not be removed until authorized by the engineer.

43. For all important work, the lumber used for face work shall be dressed to a uniform thickness and width; shall be sound and free from loose knots and secured to the studding or uprights in horizontal lines.

44. For backings and other rough work undressed lumber may be used.

45. Where corners of the masonry and other projections liable to injury occur, suitable moldings shall be placed in the angles of the forms to round or bevel them off.

46. Lumber once used in forms shall be cleaned before being used again.

Details of Construction.

47. Wherever it is necessary to splice the reinforcement otherwise than as shown on the plans, the character of the splice shall be decided by the engineer on the basis of the safe bond stress and the stress in the reinforcement at the point of splice. Splices shall not be made at points of maximum stress.

48. Concrete structures, wherever possible, shall be cast at one operation, but when this is not possible, the resulting joint shall be formed where it will least impair the strength and appearance of the structure.

49. Girders and slabs shall not be constructed over freshly formed walls or columns without permitting a period of at least four hours to elapse to provide for settlement or shrinkage in the supports. Before resuming work, the tops of such walls or columns shall be cleaned of foreign matter and laitance.

50. A triangular-shaped groove shall be formed at the surface of the concrete at vertical joints in walls and abutments.

51. Except where a special surface finish is required, a spade or special tool shall always be worked between the concrete and the form to force back the coarse aggregates and produce a mortar face.

52. Top surfaces shall generally be "struck" with a straight edge or "floated" after the coarse aggregates have been forced below the surface.

53. Where a "sidewalk finish" is called for on the plans, it shall be made by spreading a layer of 1:2 mortar at least ¾-in. thick, troweling the same to a smooth surface. This finishing coat shall be put on before the concrete has taken its initial set.

Appendix B.

Recommended Practice for Designing Reinforced Concrete Structures.

(1) The materials and workmanship for reinforced concrete should meet the requirements of the specifications for plain and reinforced concrete, presented in this report of the committee on massonry.

The concrete recommended for general use is a mixture of one part of cement to six parts of fine and coarse aggregates. A richer mixture will be found advantageous for special conditions.

(2) The dead load is to include the estimated weight of the structure and all other fixed loads and forces acting upon the structure.

(3) The live load is to include all variable and moving loads or forces acting upon the structure in any direction.

(4) As the working stresses herein recommended are for static loads, the dynamic effect of moving loads is to be added to the live load stresses.

(5) The span length for beams and slabs is to be taken as the distance from center to center of the supports, but not to exceed the clear span plus the depth of beam or slab.

(6) The internal stresses are to be calculated upon the basis of the following assumptions:

(a) A plane section before bending remains plane after bending.

(b) The distribution of compressive stresses in members subject to bending is retilinear.

(c) The ratio of the moduli of elasticity of steel and concrete is 15.

(d) The tensile stresses in the concrete are neglected in calculating the moment of resistance of beams.

(e) The initial stress in the reinforcement due to contraction or expansion in the concrete is neglected.

(f) The depth of a beam is the distance from the compressive face to the centroid of the tension reinforcement.

(g) The effective depth of a beam at any section is the distance from the centroid of the compressive stresses to the centroid of the tension reinforcement.

(h) The maximum shearing unit stress in beams is the total shear at the section divided by the product of the width of the section and the effective depth at the section considered. This maximum shearing unit stress is to be used in place of the diagonal tension stress in calculations for web stresses.

(i) The bond unit stress is equal to the vertical shear divided by the product of the total perimeter of the reinforcement in the tension side of the beam and the effective depth at the section considered.

(k) In concrete columns the concrete to a depth of 1½-in. is to be considered as a protective covering and is not to be included in the effective section.

(7)* "When the maximum shearing stresses exceed the value allowed for the concrete alone, web reinforcement must be provided to aid in carrying the diagonal tension stresses. This web reinforcement may consist of bent bars, or inclined or vertical members, attached to or looped about the horizontal reinforcement. Where inclined members are used, the connection to the horizontal reinforcement shall be such as to insure against slip.

"In the calculation of web reinforcement when the concrete alone is insufficient to take the diagonal tension the concrete may be counted upon as carrying one-third of the shear. The remainder is to be provided for by means of metal reinforcement consisting of bent bars or stirrups, but preferably both. The requisite amount of such reinforcement may be estimated on the assumption that the entire shear on a section, less the amount assumed to be carried by the concrete, is carried by the reinforcement in a length of beam equal to its depth."

(8) The following recommended working stresses, in pounds per square inch of section, are for use in concrete of such quality as to be capable of developing an average compressive strength of at least 2,000 lbs. per square inch when tested in cylinders 8 in. in diameter and 16 in. long

*The recommendations regarding web stresses are quoted from a report of the Joint Committee on Concrete and Reinforced Concrete.

and 28 days old, under laboratory conditions of manufacture and storage, the mixtuie being of the same consistency as is used in the field:

Structural steel in tension	14,000
High carbon steel in tension	17,000
Steel in compression, 15 times the compressive stress in the surrounding concrete.	
Concrete in bearing where the surface is at least twice the loaded area	700
Concrete in direct compression, without reinforcement on lengths not exceeding six times the least width	450
Concrete in direct compression with not less than 1 per cent nor over 4 per cent longitudinal reinforcement on lengths not exceeding twelve times the least width	450
Concrete in compression, on extreme fibre in cross bending	750
Concrete in shear, uncombined with tension or compression in the concrete	120
Concrete in shear, where the shearing stress is used as the measure of web stress	40
Note.—The limit of shearing stresses in the concrete, even when thoroughly reinforced for shear and diagonal tension, should not exceed	120
Bond for plain bars	80
Bond for drawn wire	40
Bond for deformed bars, depending upon form	100-150

At the Coliseum

The Roberts & Schaefer Company, Chicago, has just closed a contract with the Pennsylvania Railroad for a large Holmen cooling station for installation in Pennsylvania.

The W. F. Bossert Manufacturing Company, Utica, N. Y., space 137, is showing its latest improved switch point adjuster, of which a large number have been installed on many of the leading railways during the past two years. It is very simple, strong and compact. It has the advantage of being completely housed from the elements, which also prevents all foreign substance from clogging the working parts.

A particularly interesting feature of the exhibit of the Okonite Company, New York, is the display of the portion of a fine Para rubber biscuit, weighing 93¼ lbs., which, at the market price of $2.46 per lb., is worth $229.40. After being washed, dried and made ready for use in manufacture, owing to shrinkage and other losses, it would be worth $3 per lb. To the users of rubber insulated wire this is of interest, as it explains the present high price of this high-grade product.

The life of a rubber compound is dependent on the quality and percentage of rubber used, also the care in treating, compounding and vulcanizing. The Okonite Company's specialty is 30 per cent. fine Para rubber, the only grade which this company has ever made.

KEUFFEL & ESSER COMPANY EXHIBIT.

A very attractive exhibit in the line of surveying and drawing instruments is shown by the Keuffel & Esser Company, New York, represented by its Chicago branch in space 98. It shows the most modern instruments, as this company has made, during the last few years, many improvements in its surveying instruments, which are very neat in appearance and evidence the best of workmanship.

This company also shows a large assortment of slide rules and an 80-in. model of the Duplex slide rule which has been quite an attraction to the engineers. There is also shown a very complete line of steel measuring tapes, with the Keco finish, which protects the tape from rust. On account of the dark finish of these tapes, the figures show up very plainly and are very easily read.

LOCK JOINT CAST IRON CULVERT PIPE.

Three years ago the National lock joint cast iron culvert pipe was placed upon the market by the American Castings Company, Birmingham, Ala., and since that time it has been in use by railway companies in all parts of the country.

The National lock joint pipe is said to be lighter per foot than pressure pipe, and cheaper. As it is made in 3-ft. to 5-ft. lengths, it is easily transported and placed in the trench. Being equipped with a metal lock joint, unbelling and disjointing is impossible and no cement is required on the joints. In case of breakage, a 3-ft. unit is lost rather than a 12-ft. one, and the short units make cutting unnecessary. There are four bells in a 12-ft. length, which act as reinforcing bands to prevent crushing, and they also reduce washouts to a minimum, as each acts as an additional anchorage.

National pipe is designed especially for railway culverts, using only No. 2 and No. 3 pig iron and no scrap. The

Section of Lock Joint Cast Iron Culvert Pipe.

pipe is cast in a green sand mold, which is a decided novelty and necessity in making pipe of this character. The shrinkage strain is prevented, since the inside core member is stripped out, while the pipe is bright red hot.

Where box culverts have failed, National pipe has been used to good advantage by threading the short units through and locking the same inside of the old culvert, and filling in around the pipe as the culvert is laid. On new work, where transporting across the country is difficult, due to the fact that National pipe can be handled by one or two men and nested, haulage charges are much less.

CORRUGATED METAL CULVERTS.

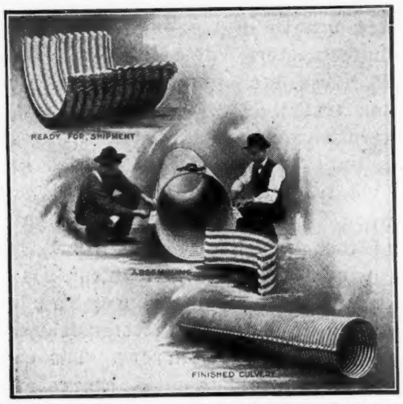
If the demand which is being made upon the Canton Culvert Company, Canton, Ohio, for its Acme corrugated metal culverts, Doro railway drains, etc., can be used as a criterion, it seems that corrugated metal culverts are recognized as among the best of underground water conductors. This culvert, while it is cheaper, in the long run, than cast iron, tile or terra cotta, though perhaps not so in first cost, is nevertheless more desirable in many particulars.

Acme culverts are so constructed as to enable shipping, hauling and handling with economy and convenience, due to the knock-down feature, and being easily set up and installed by the use of a few bolts.

They are made of heavier gauge material than has characterized corrugated culverts manufactured in the past, which, coupled with the fact that the lateral flanges along both sides and the circumferential reinforcements supplied by the lapping break joints at 12-in. intervals, makes them amply strong. These culverts are said to have proved their stability, through satisfactory use, under highways, traction railways and for other purposes.

A strong feature in favor of Acme culverts is in the fact that they are made of a special analysis iron known com-

mercially as "No-Co-Ro" metal. Ordinary galvanized sheets are more or less susceptible to the corrosive action of dirt, ashes, salt water, with which they come in contact when imbedded in the earth. Tests on "No-Co-Ro" metal, according to the specifications of the United States government



Details and Assembled Canton Culverts.

and various technical institutes, and in accordance with the recommendation of the American Society for Testing Materials, are said to prove that it is far superior, for culvert purposes, to ordinary steel, charcoal or muck bar iron, and is remarkably free from the impurities in iron which tend toward corrosion.

HAND, PUSH AND VELOCIPEDE CARS.

The Kalamazoo Railway Supply Co., Kalamazoo, Mich., whose exhibit is in booths 24 and 25, carries a complete line of hand, push and velocipede cars. The hand cars are substantially built and have the following desirable features: Pressed steel, taper wheels and pinion-fit axles, flexible steady-box, double acting brake and well trussed gallows-frame. These cars are made in 16 types. Push cars are made in ten styles, including small, light cars and large, extra heavy track-laying or rail cars. Velocipedes are made in both three and four wheel types. They are made of steel and malleable iron and the frame is trussed to give maximum strength with minimum weight. The axles revolve under anti-friction rollers and the cars are geared 3½ to 1. For inspection purposes, four-wheel cars with or without canopies are supplied.

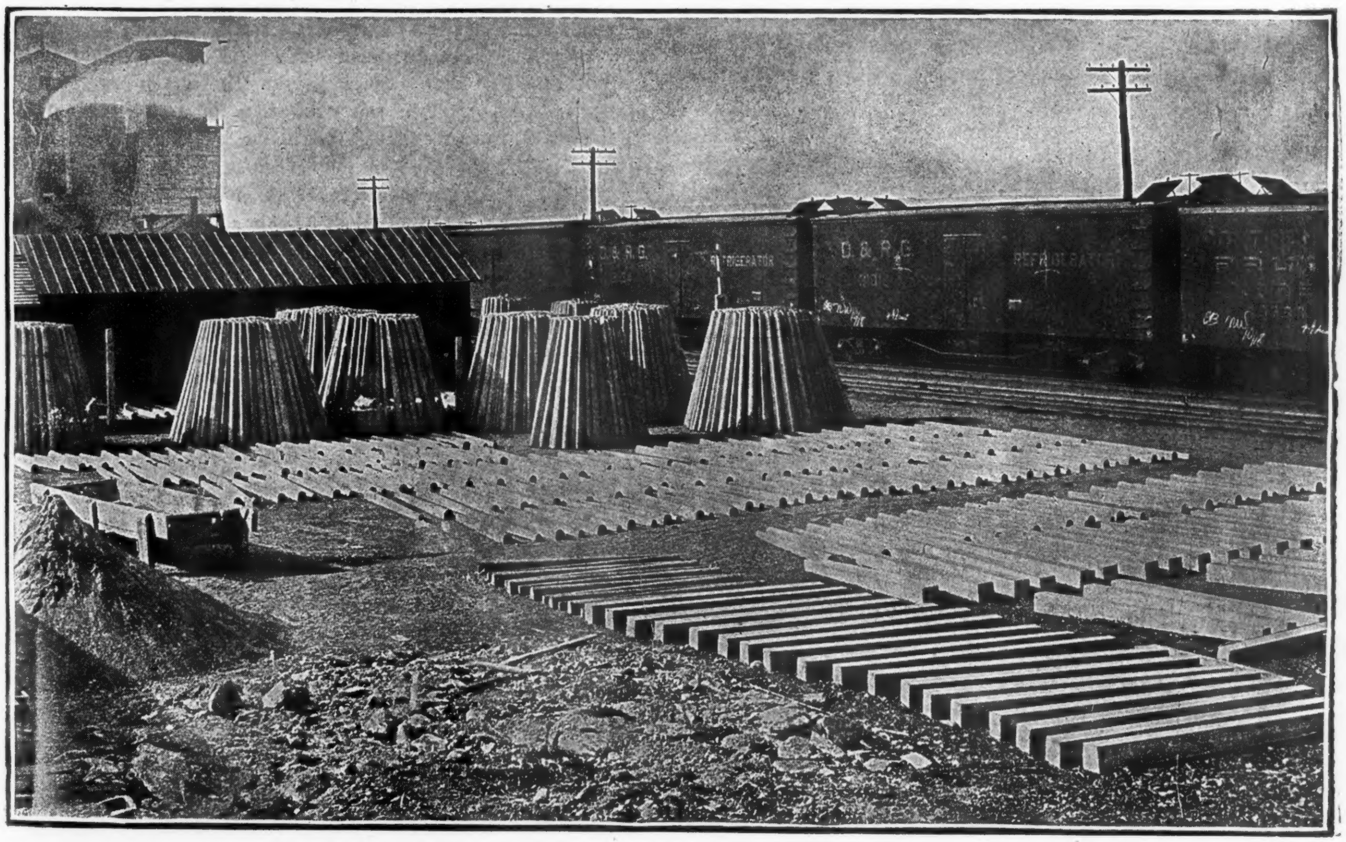
In addition to the cars mentioned, the company carries a full line of motor cars, track drills, jacks, crossing gates and other track appliances.

MODEL "R N R" MANGANESE FROGS.

The Indianapolis Switch & Frog Co., Springfield, Ohio, has on exhibition in booth 182 its model "R N R" manganese frogs. These frogs are proving their economy in service on account of lower maintenance charges and higher efficiency. By the use of all manganese frogs, three pairs of splices are saved as well as the maintenance of joints. These frogs are made to receive the track rails without any alteration and the rails are protected by manganese easers. The company also makes solid and insert manganese crossings and switch points.

REINFORCED CONCRETE FENCE POSTS.

The accompanying cut is a view of the plant of the D. & A. Post Mold Co., Three Rivers, Mich., whose exhibit is in booth 132 at the Coliseum. The posts made by this company are of concrete reinforced by four vertical steel bars; they are U-shaped in cross section and are tapered. The machine for making the posts consists of a set of ten individual molds placed on a frame for filling. Adjacent molds have their taper in opposite directions so all the molds fit tightly together to form a solid table on which the concrete is scooped or dropped from a mixer. After leveling off, the reinforcing is pressed into place by a special device



D. & A. Cement Post Plant.

furnished with the outfit. Then the concrete is compacted by vibrating the supporting frame. This method allows the ten posts to be compacted more quickly than a single one could be tamped. After removing the posts from the forms they are laid out to season, as shown in the view of the company's plant. The average cost of the posts is given as about 17 cents.

AUSTIN CUBE MIXER.

The Austin non-tilting cube mixer is now in use on 22 railways in this country, and on the Panama Canal 20 such mixers are being used which have a capacity of 64 cu. ft. each, the largest batch mixers ever built. The cube principle of mixing is used entirely, the only internal vanes being the large discharge vanes which are necessary to deposit the concrete on the discharge chute, since the mixer is non-tilting. The point of discharge is always stationary, which eliminates the spilling of concrete over the edges of wheelbarrows. These mixers are mounted on skids or trucks and are driven by steam, gasoline or electric power. There are five standard sizes.

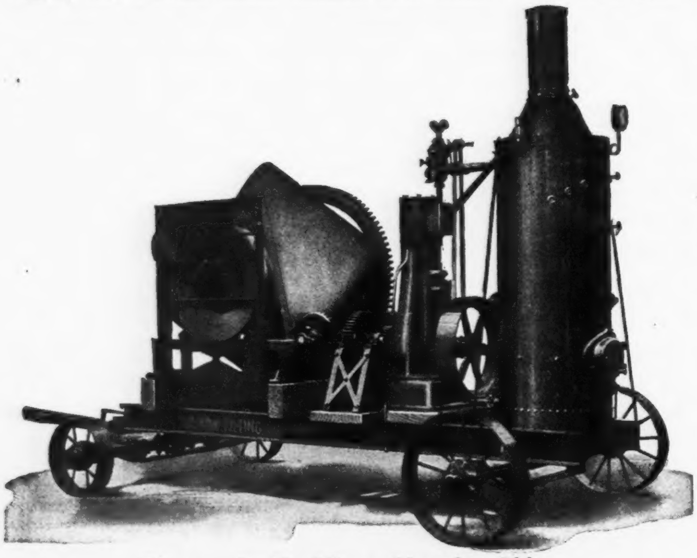


Fig. 1. Austin Mixer, Charging Side.

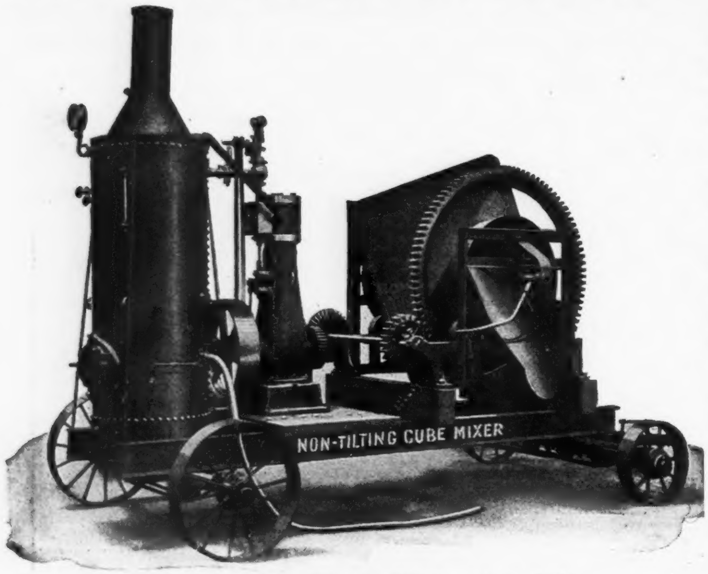


Fig. 2. Austin Mixer, Discharging Side.

The Austin mixer is one of the products of the Municipal Engineering & Contracting Co., Chicago, whose exhibit is in booth 19.

RAILWAY ENGINEER'S INSTRUMENTS.

An attractive exhibit at the Coliseum is made by the Iszard-Warren Company, Inc., Philadelphia, Pa., through its Chicago representative, the C. F. Pease Company, Chicago. The exhibit contains a complete line of surveying instruments for every branch of the engineering profession, also barometers, anemometers, field glasses, drafting instruments, parallel rulers, etc.

The precision transit No. 1 is well proportioned and of beautifully executed workmanship. This instrument is also made with an improved one-piece U-shaped standard, making a very rigid combined transit and leveling instrument for railway work. The mountain size, weighing 10 lbs., a counterpart of the precision transit No. 1, makes a very light, accurate and portable instrument. The explorer's size is a very unique instrument, weighing only five lbs. This is thought to be the smallest transit made and is designed especially for location surveys. The engineer's transit for general field work requires accurate workmanship and at the same time an ability to withstand the roughest handling without injuring the adjustments. The engineer's and contractor's Y-levels, having 15-in., 18-in. and 20-in. telescopes, have many admirers on account of the graduated levels, as well as the fine definition and the high power of the telescopes.

The most interesting feature of this exhibit is a dissected precision transit, showing the inside construction of the long tapered centers, the reinforced ribbed-cast horizontal limb and the original method of dovetailing a strip of solid silver, on which the graduations are cut. The opportunity of examining the hard perfect metal employed and the precise workmanship of the Sterling transits and levels will undoubtedly make many friends for the manufacturers.

SNYDER STEEL TIE.

The American Railway Steel Tie Company, Harrisburg, Pa., in space 217-218, has a very convincing exhibit relative to the installation and life of the Snyder steel tie. A section of rock-ballasted track with ten ties is shown. The exhibit also contains several Snyder steel ties, which, with others, were placed in track on the Pennsylvania railroad, Pittsburgh division, three years ago, where they have remained ever since. The ties shown were taken up and brought to the convention with the permission of the railway company. A number of these Snyder ties have been removed from yard to main line track, which would seem to show that they are considered applicable for the most severe service.

The standard type of this tie consists of a steel case, 5-16 in. thick, 8 ft. long. It is 7 in. wide on face by 6 in. deep. The interior of the case is filled with a mixture of asphalt and crushed stone. The sides are flanged on the asphalt filling, which holds it in place, leaving 5½ in. of the bottom of the filling exposed the entire length of the tie, which is embedded in the ballast to prevent shifting. The filling is flexible, and being exposed on the bottom of the tie, has the same resiliency as that of a wooden cross tie.

The adjustable fastening to the ties admits of adjusting the gage and aligning the track without shifting the ties, and also secures the rail to the ties by clips and bolts. It is well adapted to perfect tamping or surfacing the track, having the round corner. It conforms in size to the standard wooden cross tie. Being uniform in size, it gives a uniform support to the rails. The weight of this tie is 600 lbs., and when laid and properly aligned and surfaced, it is claimed that it can be made maintained on 40 per cent of the cost of keeping up track with wooden ties. The uniform bearing of this tie prevents low joints

LONG-SPAN SCHERZER ROLLING LIFT BRIDGE.

The Baltimore & Ohio is replacing its single-track, center-swing bridge across the Cuyahoga river at Cleveland, Ohio, with a double-track, single-leaf Scherzer rolling life bridge, having a movable span of 200 ft., center to center of bearings. In length of span for a single-leaf bridge this structure is exceeded only by the single-leaf, single-track Scherzer bridge which was built several years ago for the B. & O. across the Cuyahoga river.

During the construction of the new bridge, the regular traffic will be maintained over the existing structure by erecting the new bridge in the open position.

This is the eighth Scherzer bridge built at Cleveland and replacing center-pier swing bridges during the internal harbor improvements to accommodate large lake vessels. The designs, plans and specifications of the superstructure and operating machinery of the new bridge and also the consulting engineering services were furnished by the Scherzer Rolling Lift Bridge Company, Chicago. The Pennsylvania Steel Company, Steelton, Pa., is the contractor for the superstructure. The entire work is being supervised by A. M. Kinsman, chief engineer, and W. S. Bouton, bridge engineer of the Baltimore & Ohio.

99.94 PER CENT. PURE IRON.

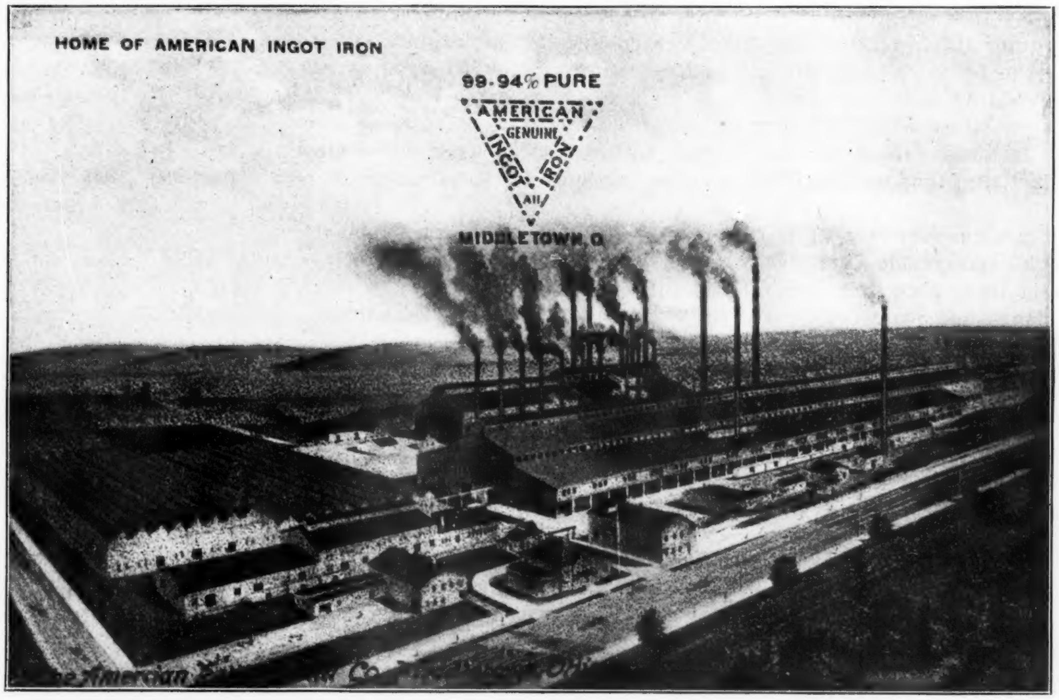
The remarkable achievement of the production of an almost chemically pure iron, developed and placed on the market by the American Rolling Mill Company of Middletown, Ohio, and known as American ingot iron, has created a considerable amount of interest and a review of the properties of this metal will indicate some of the advantages to be expected from its use.

After experimenting for a number of years, in endeavoring to eliminate the impurities and harmful elements always existing in steel, a product was finally obtained that contained at least 99.94 per cent. of iron; thus the total impurities would amount to but .06 per cent. or less.

This degree of purity was never obtained by the puddling process, and even at the present time iron wire of 99.90 per cent. of iron is used for standardizing solutions in the chemical laboratories and is sold for $1 a pound.

American ingot iron is made by a process in which the metal, while in a molten condition, is poured into molds, forming ingots, which are subsequently rolled into material demanded by the trade. While the iron is in a molten condition it is purified by the addition of suitable purifying agents, which carry the impurities into the slag and, being of less gravity than the iron, the slag floats on the surface and does not become mixed or contaminated with the iron.

Wrought iron always contains slag, the poorer grades large quantities—often amounting to two per cent., while the better grades may contain .2 per cent. It is in this respect that American ingot iron differs from wrought iron when examined under the microscope. The longitudinal sections of wrought iron always show slag lines in a network of ferrite or nearly pure iron, while American ingot iron shows the network or grains of ferrite but the absence of slag.



American Rolling Mill Co., Middletown, Ohio.

The absence of slag gives American ingot iron superior physical properties, and it has a higher tensile strength—greater elastic limit and more elongation and reduction of area than any wrought iron manufactured.

The property that has created the greatest interest is its remarkable resistance to corrosion. A sheet of American ingot iron, when immersed in a 25 per cent. solution of sulphuric acid at 70 degrees centigrade, will lose about .3 per cent of its weight in a half hour; while a sheet of Bessemer steel of the same size and gauge will dissolve completely (lose 100 per cent.) under the same conditions.

The sulphuric acid test has been recommended by the American Society for Testing Materials and shows in a quick way the comparative rust-resisting properties of iron and steel, and has been selected because of the presence of sulphur compounds in most water as well as sulphur compounds in the air formed by the combustion of sulphur in coal.

Open-hearth steel will not show as much loss in an acid

solution as Bessemer steel. This is probably due to the Bessemer steel containing more gases.

It is possible to degasify American ingot iron so completely that a cross-section of the ingot obtained by cutting the ingot in two will not show a blowhole. Some grades of steel will contain so much gas or so many blowholes that a cross-section will look like a piece of Swiss cheese.

The reason for degasifying and eliminating all of the impurities usually found in steel is because modern research has shown that corrosion is caused by electrolysis, whereby the impurities, being electro-negative to iron, in the presence of moisture, electric currents are generated with the destruction of the more electro-positive metals.

The metal manganese, which is always found in steel, is more electro-positive to the impurities than iron, and the electric currents generated will destroy the manganese first and cause pitting or tubercular corrosion, especially where the manganese has segregated.

As American ingot iron contains but traces of manganese, and the impurities being at a minimum, there will be no segregation, hence no tubercular corrosion and fewer electric currents.

The high permeability of American ingot iron makes it suitable for magnets and other electrical purposes where the best Swedish iron has been used.

In welding properties it is superior to either wrought iron or steel. It also enamels far better, and has higher electrical conductivity, thus making it suitable for telephone wire.

In stamping and deep-drawing, it is far superior to steel on account of its remarkable ductility.

At the present time, American ingot iron is only made in the form of sheets and plates. However, it is hoped that in the near future it will be used for making wire and nails, as well as many other articles.

Five basic patents have been granted on this product by the U. S. government to the International Metal Products Company.

UNION SWITCH & SIGNAL EXHIBIT.

The exhibit of the Union Switch & Signal Company, Swissvale, Pa., is remarkable, chiefly, for the number of signal mechanisms displayed. There are four top post signals and two bottom post signals.

The exhibits may be briefly described as follows:

Top post, three position, electro-pneumatic signal. This is designed for either automatic block or interlocking work.

Top post, three position, style T, low voltage signal. This signal has no dashpot, the shock of the blade returning to stop being absorbed by a snubbing circuit on the motor. This necessitates driving all the gears and the motor backwards; therefore, as an extra precaution, the circuits are so arranged as to cause the motor to pull the signal to stop should it tend to stick clear. This signal can be furnished either to sit on top of a pipe post or to bolt to the side of a post.

Top post, three position, style T, high voltage signal. In all respects the same as the former, except designed to operate on 110-volt circuit.

Top post, three position, style D signal. This signal is designed to meet the views of such persons as object to driving the gears and motor backwards when the signal goes to the stop position. A smaller motor is here used than in style T, and there is greater gear reduction. A slot is used to engage and disengage the motor and the semaphore shaft. One novel feature of this signal is the double-acting air buffer, with mechanically actuated valves, so arranged as to cause retardation both of compression and vacuum.

The post signals are the well-known style B and style S, both three position, low voltage.

Electro-pneumatic interlocking machine connected to a subway motion plate type switch and lock movement and the top post three position signal. The machine is equipped with electric lights below the levers to show whether or not a track section is occupied.

Multiple unit electric interlocking machine connected with motion plate, screw-driven switch and lock movement and solenoid dwarf signal.

Set of staff machines modified so that they can be manipulated by trainmen, thus doing away with the necessity for operators, provided all trains stop at all stations.

Controlled manual block instrument connected to upper quadrant, three position train order signal with universal spectacle.

Cable post with relay box and switch indicator, as used by the Rock Island. Also double disk and semaphore indicator, so arranged in one instrument that one repeats the position of the home signal and the other announces the approach of a train.

Circuit controlled for eight independent circuits. Contacts adjustable.

"Electro-pneumatic relay," an electro-pneumatically controlled circuit controller, used as a repeating relay where a great many circuits must be controlled by one relay.

Type 9-C neutral and polarized relays.

Alternating current, ordinary induction and frequency vane type relays. Galvanometer and induction motor type polyphase relays.

Clockwork-driven slow hand release for electric locking circuits.

Storage battery charging switch.

Adjustable resistances to be used with storage battery on track circuits.

Testing sets for relay inspectors.

Deflecting bars, both vertical and horizontal.

Pipe carriers and foundation tapes of iron "Sheradized" or impregnated 3-16 in. with zinc dust, so as to prevent rust and make painting unnecessary.

Highway crossing bell, with relay box and sign on iron post.

Electrically driven crossing gate, with positive drive up and down, equipped with buffer to absorb shock.

NEW LORAIN STEEL COMPANY SHOPS.

The use of manganese steel in the track equipment of steam railways has, during the last few years, become so general that it has ceased to be a curiosity and railway engineers generally have realized the important part this metal plays in the maintenance of track under the constantly increasing demands of steam railway traffic. The Lorain Steel Company, Johnstown, Pa., has added to its large plant a new shop devoted especially to the manufacture of steam railway frogs, crossings and switches, in which the use of manganese steel is employed to the best advantage. Frogs of every angle or rail section are made in the shops, which are equipped with the latest and most advanced types of machinery for this particular product. The designs embody the best features of track equipment, whether of solid manganese or partial manganese and rolled rail combined.

Steam railway crossings, heretofore made of rails or in combination with manganese intersections, are now made of manganese steel of one piece, or in halves, proportioned to the angle of the intersecting tracks. This type of crossing eliminates the small brackets, bolts and fillers, and is rapidly replacing the construction known among railway men as the "three-rail type."

BAUSCH & LOMB SUPERIOR TRANSITS AND LEVELS.

In the manufacture of transits and levels there is great need for the highest class of workmanship, perfection of materials and accuracy of adjustment. The superior transits and levels shown in booth 17, are made by the Bausch & Lomb Optical Co., Rochester, N. Y., under the personal supervision of George N. Saegmuller and have many important improvements. The graduations are on silver so alloyed that it will not tarnish and the accuracy of the divisions is insured by the use of the latest design of automatic dividing engine. The lenses used have large apertures, fully utilized, insuring large field, perfect detail and definition. The centers are long and ground free from eccentricity and are fitted with the greatest possible care. The special features claimed for these transits are variable power eyepiece, new construction of magnetic needle, plate levels inside of com-

Improved Baush & Lomb Transit.

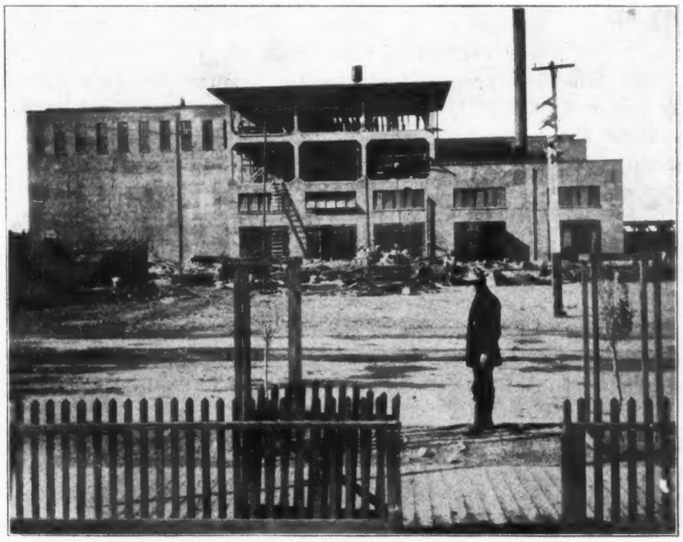
pass box, continuous variation plate, consolidation type "U" standards, hermetically sealed telescopes, patent interior focusing system, brilliant axial illumination, interchangeable Penta-prism with adjustments for parallelism and alignment.

In addition to the exhibit at the Coliseum, these instruments can be seen at the company's branch office at room 509, 103 State street.

WATERPROOF LITH.

The Union Pacific is at present reconstructing its ice house at Grand Island, Neb., to increase its efficiency. The house was built of several layers of boards and building paper, with air spaces between the layers. A false gabled roof was built over the roof proper, which was flat, and ventilators were left open at each end of the building to allow for circulation of air under the gabled roof. With this construction, the total loss of ice was about 35 per cent. to 40 per cent.

In the reconstruction an insulating layer is being applied to the inner walls, consisting of one layer of insulating paper, two inches of waterproof Lith, another layer of insulating paper and an interior lining of matched lumber. The old roof was removed, and a floor of ⅞-in. T. & G. flooring laid at the top of plates. On this floor was laid one thickness of insulating paper, three inches of waterproof Lith and a heavy coating of asphalt. The false roof was re-



Union Pacific Ice House at Grand Island, Nebr.

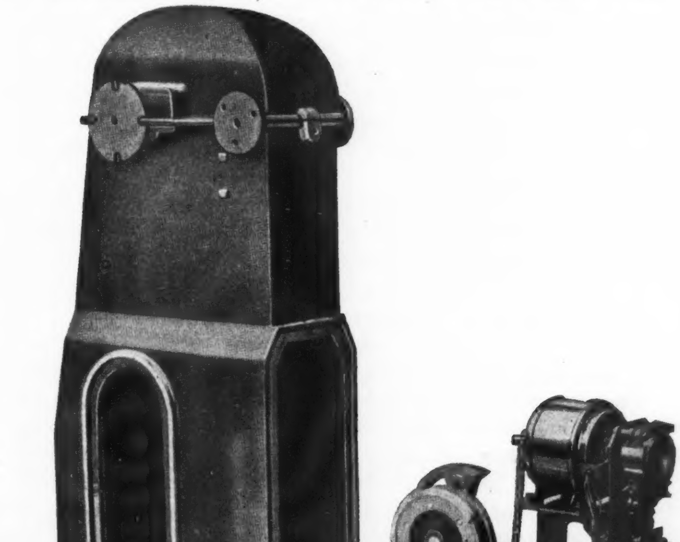
placed and the free ventilation provided for as before. This type of construction reduces the total ice loss to less than 7 per cent.

The waterproof Lith is one of the products of the Union Fibre Co., Winona, Minn., whose exhibit is in booth 171 at the Coliseum.

CROSSING GATES.

One of the exhibits of the Buda Co. in booths 87-90 at the Coliseum is its new type of electrically operated crossing gate. The accompanying illustration shows the gate post and operating mechanism.

Two and three crossings may be handled by one man and in many cases, where the view from the station is ob-



Electric Crossing Gates.

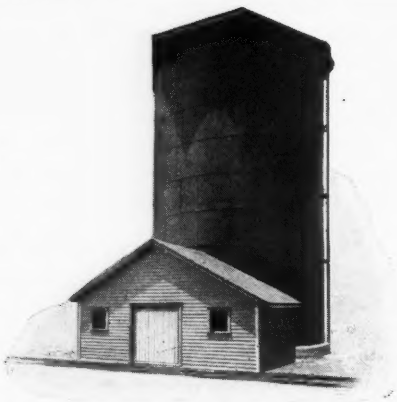
structed, the agent or operator is able to handle the gates, in addition to his other duties. No physical exertion is necessary as the gates are controlled entirely by an electric current, through a switch, which may be installed at the point most convenient for the operator. The apparatus is furnished with either direct or alternating current motors, at the option of the purchaser. A storage battery may be used if the voltage of the battery is the same as that for which the motor equipment was designed.

The following special features are claimed for this gate by the makers: It is easy to operate, being controlled by a switch; the arms may be stopped instantly at any angle; the direction of movement of the arms can be reversed at any point; the constant attention of an operator is not required; an automatic cut-off is provided which stops the arms when they have reached a set limit in either direction; there is no lost motion, the arms responding at once to a movement of the switch. The gates are arranged for two or more posts.

KENNICOTT GROUND-OPERATED WATER SOFTENER.

The type "K" Kennicott ground-operated water softener, illustrated herewith, is similar to those now being erected at several points on various railways in the United States.

Besides the merits of the regular type "K" Kennicott, this machine has the additional advantage of ground operation. It is not necessary for the attendant to climb to the top of the apparatus, for all machinery is located in a small house at the foot of the single large tank in which the entire mechanism is contained. In the type "K" machine all parts move in a positive rotary direction, which makes the operation simple.



Kennicott Ground-Operated Water Softener.

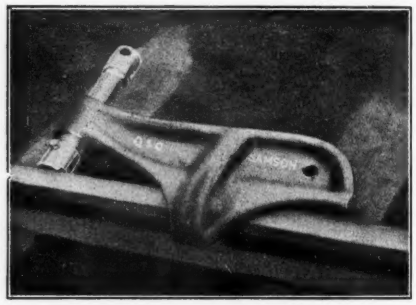
This water softener is one of the products of the Kennicott Water Softener Company, Chicago Heights, Ill., whose exhibit is in booth 74 at the Coliseum.

Q. & C. SAMSON RAIL BENDER.

Maintenance men have generally experienced difficulty in transporting a heavy rail bender, with the result that it is seldom where most needed, necessitating a shift in the repairs or delay of work until the bender can be moved.

To meet this condition the Q. & C. Samson rail bender was designed, and the large sale of them would seem to prove their popularity and effectiveness. This bender is designed especially for T-rails up to 100 pounds per yard weight, either in or out of track. Its rapidity of action and portability has made it a favorite, and many railways are equipping every section with a bender instead of the usual practice of having one of the heavier design serve a division, or at least a district.

The Q. & C. Samson rail bender weighs 100 pounds and can easily be transported on a hand car. It is particularly adapted to bending stock rails, guard rails, etc., aside from the usual functions of the bender, and is a most valuable addition to any wrecking outfit. This bender is shown at the exhibit of the Q. & C. Co., New York, in spaces 119-120 at the Coliseum, and representatives of the company will gladly explain it to interested parties.

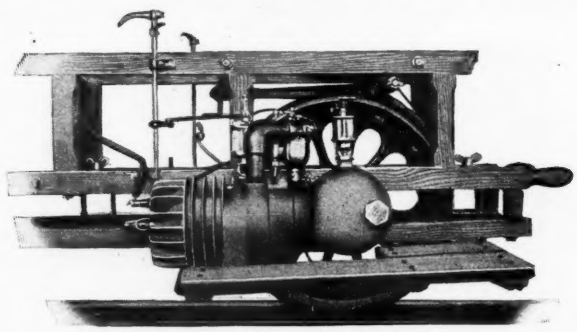


Samson Rail Bender.

ADAMS MOTOR CAR.

The accompanying cut shows a near view of the two-cycle reversible, air-cooled, direct-connected motor of the Adams motor car. The main engine bearing is 1⅜ in. in diameter by 4½ in. long. All of the working parts are enclosed so as ot exclude dirt and grit and retain the oil. The cylinder and crank-case are ground, metal to metal, their being no packing to blow out and therefore no loss of compression or oil to spatter the clothes of the operator.

Jump-spark ignition, a Schebler carburetor and sight-feed oil cups are used. For convenience a simple compression relief is provided to facilitate starting and enable coasting. The compression can also be used as a brake by leaving the compression relief closed. The batteries, spark coil, switch and tools are inclosed in a box, by locking which the operator can prevent the car being started or the batteries run down in his absence.



Detail of Adams Motor Car.

Safety is assured by limiting the speed so that the maximum will be under 30 miles an hour and without decreasing the power available. This requirement must be specified in advance. The fuel consumption is one gallon of gasoline for a 70 to 90-mile run, depending on weather conditions.

The Adams motor car, made by Burton W. Mudge & Co., Chicago, is on exhibition in spaces 113-114, Coliseum.

CONCRETE FENCE POSTS.

The D. & A. Post Mold Company, Three Rivers, Mich., exhibits in Space 132 molds for reinforced concrete fence posts which are now in use by five of the leading railways, also by concrete products companies in various parts of the country.

The D. & A. shaking system makes 10 wet-mix concrete posts at one time. The machine consists of ten 10-in. or 6-in.

U-shaped steel troughs, placed upon a frame about two feet high. When the molds are in position for filling, the flanges overlap, forming a table upon which the concrete is shoveled or dropped from a mixer and leveled off. With the placing device, the reinforcements are pressed into the wet concrete, after which it is thoroughly compacted, by vibrating the molds lengthwise, which is said to be much quicker than one single post could be tamped. The filled molds are then placed upon soft, level ground, and when the concrete is sufficiently set, the molds are inverted and the ends removed, which releases the post.

Three slightly different mixtures are employed in the manufacture of concrete fence posts. The dry mixture is tamped or pressed for compacting; the wet mixture is usually settled by pressing or agitation, and the slush mixture is made thin for pouring into the molds or forms. A dry mixture is one which will allow immediate removal of the forms, while the wet requires that the posts be left in the molds for from 6 to 24 hours, or until the initial set has taken place. Posts made with slush concrete require to be left in the molds for about 48 hours.

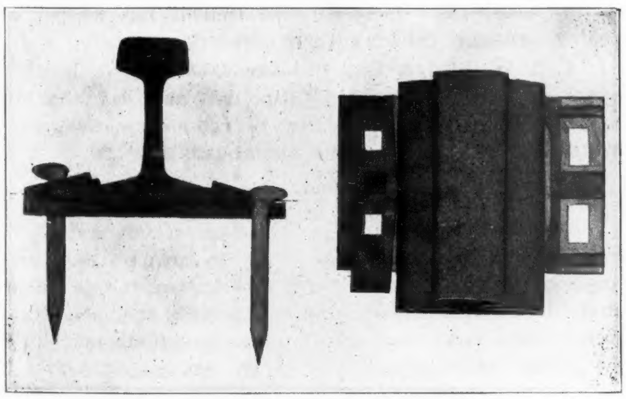
The labor cost in the manufacture of concrete fence posts is said to be reduced by the use of wet mixture concrete, since it does away with tamping. The use of a multiple mold, such as the D. & A., is also a time saver.

SECURITY ANCHOR TIE PLATE.

The Security anchor tie plate performs two functions in addition to that of an ordinary tie plate, viz., that of a rail anchor, to prevent the creeping of rails, and that of a rail brace, to prevent their tilting on curves.

For use as a rail anchor, the device is applied to the unbroken rail on each joint tie, that is, at the other end of the tie from the rail joint.

Its construction is such that the edge of the rail base bears against the plate in three places, as shown in the accompanying cut, and if the plate is rotated about one of these points, its grip on the rail will be strengthened. The angle bars at the rail joint are spiked to the tie and bolted to the rail ends, so, if the rail creeps, the tie will



Security Anchor Tie Plate.

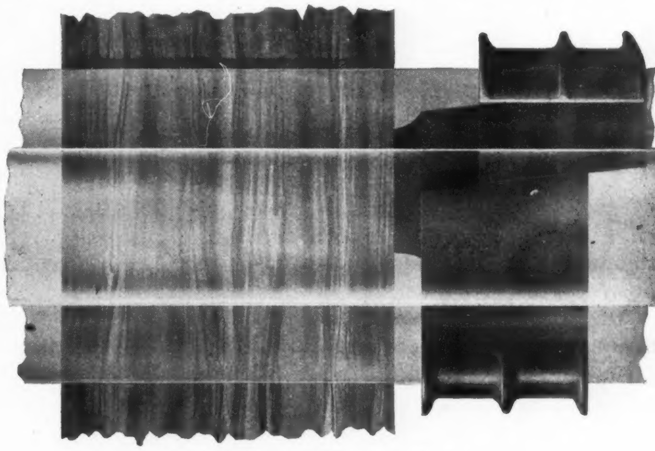
be slued in the track. This motion will tend to rotate the plate which is spiked to the other end of the tie, and that rotation will cause it to grip the rail as described above. This is a new application of the old idea of staggering the spikes in the joint tie. That method prevented creeping only so long as the spikes held firm, but the holding power of the anchor tie plate is not affected by the loosening of the spikes.

When used as a brace on curves, the overlapping of the rail base is the important feature of construction. The plate firmly grasps the base of the rail and, in addition to this, greatly increases the width of the rails bearing on the tie.

The Security anchor tie plate is being exhibited by the W. K. Kenly Company, Chicago, in booths 78 and 79.

P. & M. RAIL ANCHOR.

The P. & M. rail anchor is one of the products of the Railway Specialty & Supply Co., Chicago, on exhibition in booth 105 at the Coliseum. The accompanying cut shows very clearly the application of the device to the rail. It



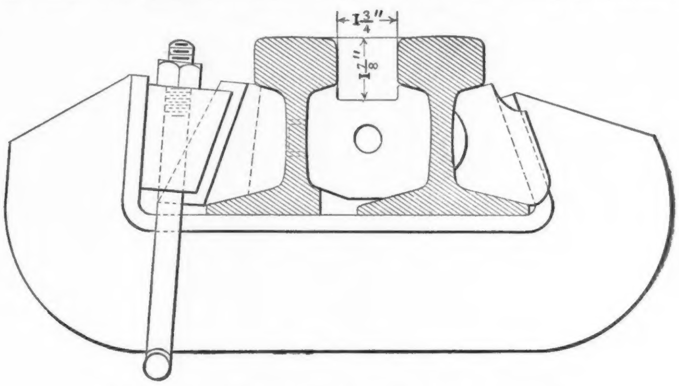
Rail Anchor Applied.

consists of two simple parts which automatically tighten as the rail creeps, and which maintain their grip on the rail base whether there is pressure against it or not. The creeper is adapted to single as well as double track.

RAMAPO GUARD RAIL CLAMPS.

In the accompanying line cuts are shown elevation and plan views of a guard rail clamp of unique construction, manufactured by the Ramapo Iron Works, Hillburn, N. Y.

The adjustments are made, through the wedge blocks, by tightening the nuts on the U-bolt. The U-bolt passes under a very rigid Tee steel yoke, made of a special quality of steel not affected by low temperature. This yoke, while offering exceptional rigidity, cannot, it is said, be broken at zero temperature under a blow even by a heavy steam



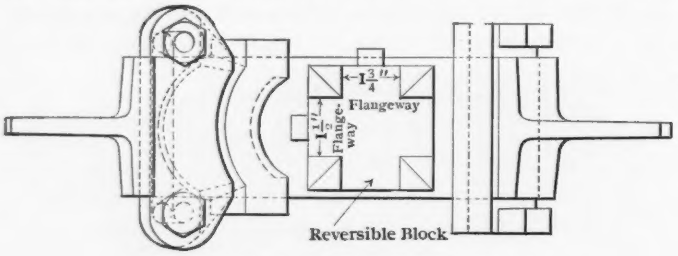
Elevation of Ramapo Guard Rail Clamps.

hammer, which, however, might cause considerable distortion.

The illustration shows a reversible block. The same clamp may be furnished with adjustable blocks held in position by a stud projecting through a drilled hole in the guard rail or by lugs engaging the clamp. In the latter case it is not necessary to drill the guard rail. The manufacturers, however, recommend the rigid reversible

block, offering the one adjustment for wear or for different flangeways at different locations, and when the guard rails are drilled, the stud on the block insures the clamp being placed in the correct location.

This clamp is very economical and compact in form. It is claimed that under the hardest service it will not work loose or rattle if tightened up when the blocks are well seated after a few weeks' service. The nuts may be held by any special nutlock, but the manufacturers furnish a



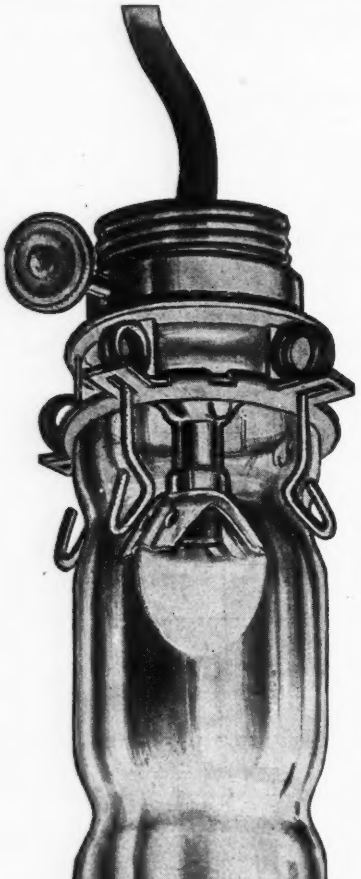
Plan of Ramapo Guard Rail Clamp.

tight-fitting thread, which, in addition to one of the improved types of nutlocks, insures the best service.

Although these clamps have been but recently placed upon the market, there are said to be several thousand giving very satisfactory service on several of the larger railways.

ADLAKE LONG-TIME BURNERS.

The Adams & Westlake Co. Chicago, are exhibiting at their booth, Adlake long-time burners, for which they



Flat-Flame, Long-Time Burner.

will burn from five to six times as long, upon a given claim a remarkable record for reducing the cost of maintenance of signal lamps. Repeated tests have shown that quantity of oil, as the ordinary signal lamp burners, and they are remarkable time savers, in that they require attention but once a week. It is claimed that the saving effected in maintenance is sufficient to buy a new Adlake

Flat-Flame, No-Chimney, Long-Time Burner.

lamp in 15 months. It is said that one of the leading railways in England is saving £200 annually ($1,000) in lamp tenders' wages only, on a section where 200 Adlake lamps are in use, because one man is now doing what it took five men to do before they adopted the Adlake signal lamp with long-time burners.

RIPOLIN ENAMEL PAINT.

Possibly the best known enamel paint in Europe is that special old Dutch brand, called "Ripolin." It is the product of an old Dutch hand process, originated by a paint master, and has become famous in the old world. For the last few years Messrs. J. A. & W. Bird & Co., Boston, Mass., have been importers and American agents for this paint, and with very little advertising it has worked its way all over this country. It has been largely used for painting railway stations and for signals, and the standard signal colors in which it is manufactured are permanent. One of the features of this paint is its smooth flowing under the brush, and it is claimed that it has 30 per cent. greater covering capacity than domestic paints.

J. A. & W. Bird & Co., who are exhibiting in booth 140, report a large business in "Ripolin," and say that it is rapidly being adopted by railway systems as the standard for their railway station and signal paints.

The Edison Manufacturing Company, of Orange, N. J., is showing a full line of Edison B. S. Co. primary cells at the Coliseum. An interesting feature of the exhibit is the combination of soda, copper, oxide cells with the new heat resisting glass jars. Among other improvements in their line the Edison Manufacturing Company has added a cell having a rectangular heat resisting glass jar, which, in addition to making a very attractive appearing cell, makes it possible to save considerable space in the housing of signal batteries. This should result in a saving to roads having locations where the temperature does not reach a point low enough to affect gravity cell track batteries, as by the use of cells with the new rectangular jars the track battery may be housed in signal post battery cases, thus saving the cost of track battery chutes and the installation of the same.

Several improvements have been made in the construction of Edison B. S. Co. Elements which not only effect a decrease in internal resistance of these cells, but also affords greater reliability.

HOISTS AND JACKS

Although the exhibition by the Road and Track Supply Association is held to show the apparatus and material which is of interest to the maintenance of way and engineering departments of railways, interest is taken in it by all railway departments. Among the exhibitors to whom this is of special importance is the Weir & Craig Manufacturing Co., who have in addition to their air and electric turntable tractors, a complete line of compressed air portable geared hoists and pneumatic and hydraulic locomotive pit jacks.

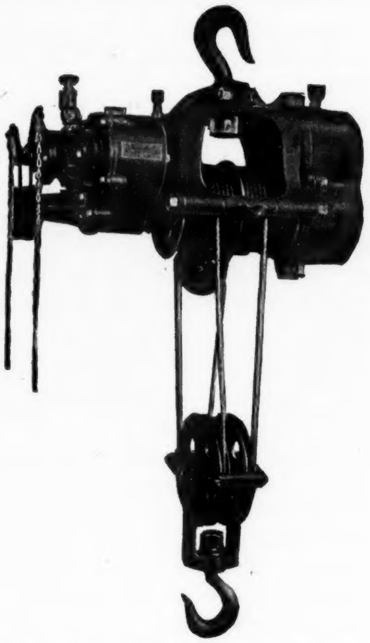


Fig. 1. Compound Air Geared Hoist.

The accompanying illustrations show two of these machines which are on exhibition at the Coliseum, Fig. 1 being the compressed air geared hoist and Fig. 2 the pneumatic locomotive drop pit jack. Among the various features claimed for the hoists are the following: They require small amount of head room; they are compact, and they are entirely closed. The pneumatic jack is so designed as to give a lift of five and one-half feet with a capacity of 18,000 lb. net at 80 lb. air pressure.

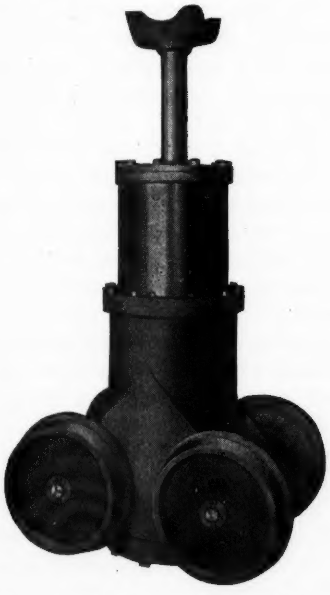


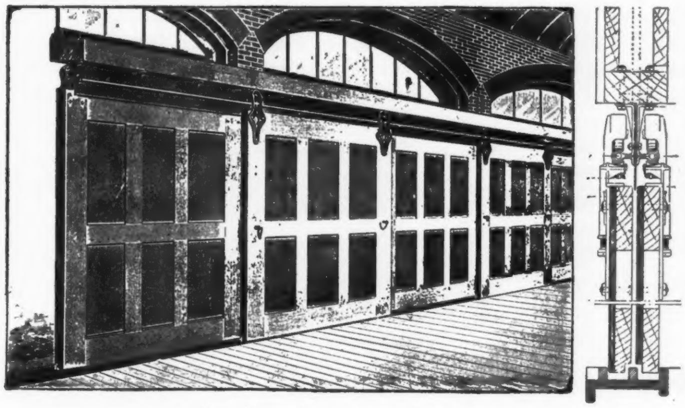
Fig. 2. Pneumatic Locomotive Drop Pit Jack.

The hydraulic jacks are of about the same general design, a feature of importance in each being the small amount of clearance necessary below the top of the drop pit rail.

ALLITH PARALLEL DOOR EQUIPMENT.

The Allith Manufacturing Company, Chicago, makes a parallel door equipment, shown in the accompanying cut, which is especially applicable to the doors of freight stations and warehouses.

This equipment is designed to meet the exacting requirements of maintenance. These continuous sliding parallel doors, as a result of service test, show many points of superiority, and have been adopted as a standard by a large number of railways.

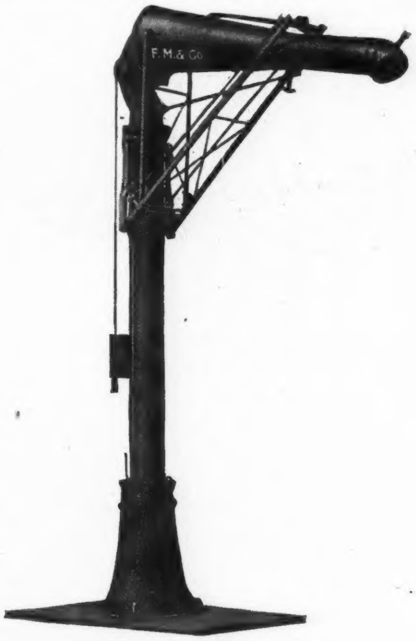


Allith Parallel Door Equipments.

The Allith Manufacturing Company is exhibiting this equipment in booth 116.

SHEFFIELD STANDPIPE.

The standpipe illustrated herewith has three distinctive features in its design; (1) the spout is not of the ordinary flexible type, (2) the pipe has a vertical telescoping movement, and (3) the main valve is adjustable for variations in pressure.



Sheffield Standpipe.

The flexible spout is often hard for the fireman to control, especially when the pressure is high. The Sheffield spout has a goose neck, shown in the illustration, which directs the force of the water downward as it leaves the

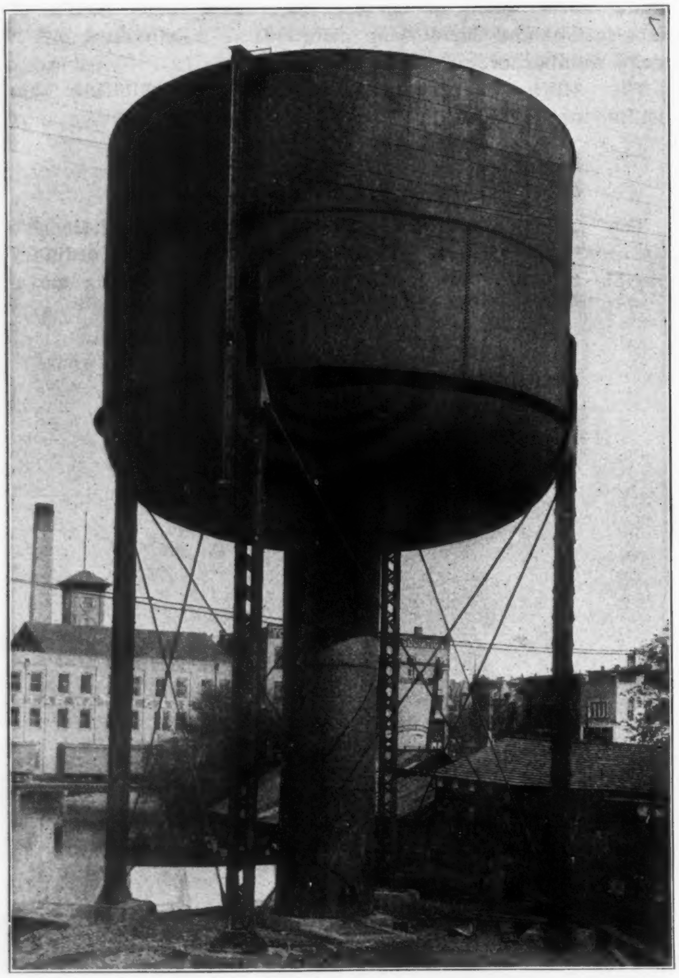
discharge end, so that the pressure of the spout is vertical, instead of horizontal. The telescoping movement of the pipe permits a variation of about 5 ft. in the elevation of the spout, which is an important advantage when high and low tenders are in service on the same line. This telescopic pipe has been in use for four or five years, and the repeated orders from satisfied users are evidence of its satisfactory performance.

In connection with the adjustable main valve, this water column is furnished with a hydraulic relief valve. This prevents the breaking of water mains by "water hammer," due to closing the standpipe valves too quickly and effects a large saving in repairs necessary after such a failure. Fairbanks, Morse & Co., Chicago, the makers of the Sheffield standpipe, have also a number of other designs which are illustrated in a special pamphlet which they mail to interested parties.

STEEL RAILWAY TANKS.

The accompanying cut shows one of the standard hemispherical-bottom tanks built by the Chicago Bridge & Iron Works, Chicago, for the Chicago, Milwaukee & St. Paul at Elgin, Ill. It has a capacity of 10,000 gal., and is 45 ft. 2 in. high.

Steel tanks are superior to wooden ones on account of their longer life, smaller expense for maintenance and ability to remain water-tight under all conditions. In this design the supply pipe is made so large that it cannot freeze solid in winter, thus eliminating the danger of ice forming in the valves, without the use of wooden lagging, which is often resorted to for this purpose. This large supply pipe has the valves located at its center, so that ice forming on the sides of the pipe will not interfere with the operation of the tank. The large cylinder also serves as a settling basin for sediment which can be drawn off through a valve in the bottom without emptying the tank. The hemispherical bottom effects a material saving in cost, since it is self-supporting and eliminates the heavy beams necessary in a flat-bottom tank. The cost of the hemispherical-bottom tank is about the same as that of a wooden tank with steel substructure.



Hemispherical Bottom Railway Tank.

Economy in pumping requires that a tank have a large diameter and low height, which has been hard to attain in self-supporting bottom tanks, for the bottoms are only self-supporting for small diameters. This is not the case with the hemispherical bottom, and the tanks can be built to allow economical pumping.

In addition to these tanks, the Chicago Bridge & Iron Co. builds steel smoke stacks, portable tie-preserving retorts, bridges, trestles, etc.

ROCKFORD ECONOMY.

The following facts and figures were collected by the Duntley Manufacturing Co., Chicago, makers of the Rockford motor car, which was described in the Daily Railway Age Gazette of Monday.

A large American railway which is now a large user of motor cars investigated the subject carefully before adopting them and prepared estimates of the amount of money that could be saved by their use. For this purpose they used the records of one of their divisions, which they later equipped with motor cars. This division is 129 miles long, double track, or 258 miles altogether. According to their estimates they could save $11,000 per year, while actual service has shown a saving of $25,060 per year. They have figured interest on their investment at 6 per cent; depreciation, 20 per cent., and repairs at 10 per cent., and this amount deducted from the total saving for the year still shows a saving of $89.59 per mile per year.

The Duntley company is prepared to vouch for the accuracy and correctness of the above statements, and have asked information from other roads which have adopted or are experimenting with Rockford cars, the following being extracts from their replies:

"We have never had any trouble with the Rockford car, and no trouble in taking care of the work in better shape than it was taken care of before with three crews, saving the company about $110 per month."

"It is hard to estimate the exact saving, but we judge it to be from 10 per cent. to 20 per cent. over the ordinary hand car method."

"I have reduced our track expenses about one-third on my division without effecting the service by the reduction; in fact, we have gained in service in many ways."

"The two Rockford cars which we have showed a saving of over $1,000 last season."

"The car has made the saving that I thought it would. We have been able to dispense with one foreman, and have made a net saving in wages alone of $47 per month. As to the amount of time saved by the whole gang, it is difficult to arrive at exact figures, but I have estimated this to be not less than $25 per month, making a total saving of $72."

"With nine cars we have cut out four sections entirely, making a saving of the wages of four foremen and six laborers, making a total saving on the division at the present rate of wages of $464.60 per month. This saving is based on winter conditions, where gang consists of one foreman and one or two laborers."